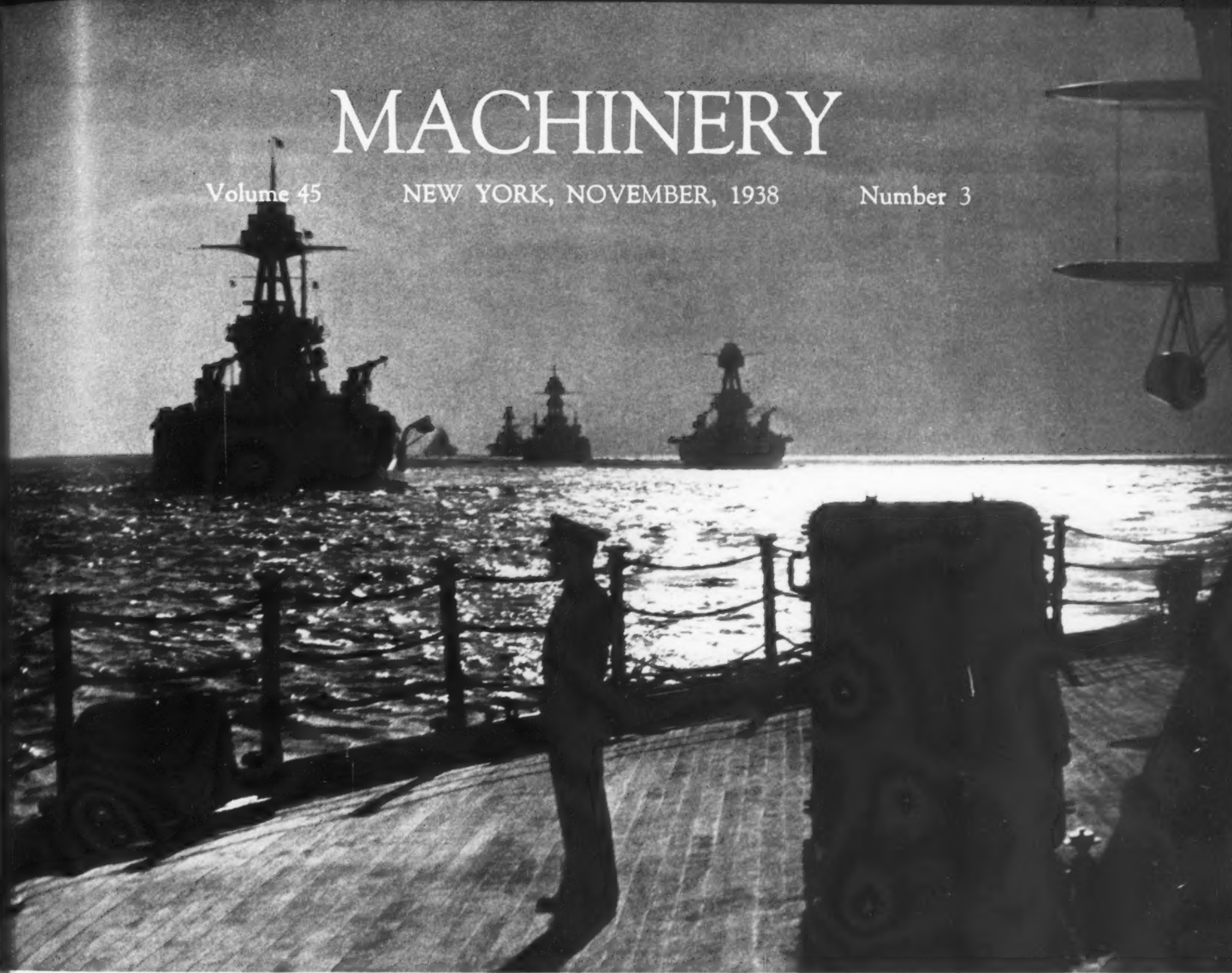
MACHINERY

Volume 45 NEW YORK, NOVEMBER, 1938 Number 3



The Navy Expansion Program and Its Importance to Industry

By REAR-ADMIRAL H. G. BOWEN
Engineer-in-Chief, United States Navy

THE recent "Twenty Per Cent Increase in Navy" legislation passed by Congress provides authorization for a combatant Navy of 20 per cent greater under-age tonnage than our "5-5-3 Treaty Navy." The Vinson Trammell Act of 1934, in addition to making provision for building the United States Navy up to treaty strength, authorized the replacement of over-age vessels. The building program now going on and in prospect has three components:

1. Building up to the "treaty strength." (The last lot of this component will be laid down in the current fiscal year.)

2. Expanding the Treaty Navy by 20 per cent. (The first lot of this component will be laid down in the current fiscal year.)

3. Continuous replacement of vessels that become of "age" as defined by the Treaty of London, March 25, 1936.

There are no provisions in the legislation as to when the prescribed under-age strength shall be attained. It is presumably the intent to build as rapidly as the country's facilities will permit. Because of the continuous replacement feature, the program operates in perpetuity. For the purpose of estimates and study, therefore, it is necessary to assume a span of time, and set down the actual building which, in accordance with existing authorization, will accrue within that span. For present consideration, a ten-year period will be assumed, as it appears that existing facilities can just about keep pace with over-age replacements and complete authorized increases in that time. This will require, besides the completion of 56 vessels now being built, the construction of 150 to 200 others.

Funds for a shipbuilding program are appropriated from year to year. Certainty as to the program, therefore, exists only to the extent of the money in hand. The money in hand from all sources for carrying out the program in the current fiscal year totals $154,113,150. This provides for the continuation of construction already under way and the laying down of the following additional ships: 4 battleships; 4 cruisers; 1 airplane carrier; 8 destroyers; 6 submarines; 1 submarine tender; 1 destroyer tender; 3 seaplane tenders; 3 tankers; 1 mine layer; 2 mine sweepers; and 3 fleet tugs.

The cost of the ships to be constructed during the next ten years will probably reach two and one-quarter billions of dollars, which will result in an average expenditure of $225,000,000 a year. Starting from the present level of $154,000,000, the annual expenditure will increase to a peak somewhere near the middle of the program, and then taper off to zero. Annual peak expenditures will probably exceed $300,000,000.

Rehabilitation of Navy Yards

It has been, and will no doubt continue to be, the policy to divide United States Navy shipbuilding equally between Navy Yards and private shipyards. The completion of the building program outlined will tax all existing facilities, both government and private, to their limit. It has been estimated that at the peak load of the program (based on a 50-50 division of the load between private industry and the Navy), Navy Yards will be employing more than twice as many men as at present.

To enable the Yards to meet the building program and also to better serve the larger fleet that will result therefrom, a program of rehabilitation of the Yards, including shops and equipment, was initiated by the Navy Department early this year. Funds for this purpose have since been appropriated by Congress or otherwise provided by WPA and PWA allotments and made available for expenditure in the current fiscal year as follows:

1. Shop Tools and Equipment		$8,200,000
Navy Yards	$5,250,000	
Ordnance Activities	2,100,000	
Schools	250,000	
Aeronautical Activities	500,000	
Others	100,000	
	$8,200,000	
2. Improvement of Shop Buildings and Other Yard Facilities		$38,616,500
(a) Buildings (new and improvements)	$17,720,500	
(b) Dry Docks (new and improvements)	4,900,000	
(c) Shipbuilding ways (new and improvements)	3,145,000	
(d) Sea walls, wharfs, etc.	3,075,000	
(e) Weight-handling and transportation equipment, including heavy-duty cranes	3,876,000	
(f) Improvement of power plants	2,980,000	
(g) Improvement of electric circuits, piping systems, etc.	2,455,000	
(h) Miscellaneous	465,000	
	$38,616,500	

The authorized expenditures for 1939 (fiscal year) in connection with the shipbuilding program are, therefore, as follows:

1. Improvement of shops and other yard facilities	$38,616,500
2. Machine tools and other shop equipment	8,200,000
3. Ship construction	154,113,150
Total (1939 fiscal)	$200,929,650

Item (1) of the above is virtually non-recurring

ITS IMPORTANCE TO INDUSTRY

after 1939, because all prospective improvements of the nature included in this item have been provided for in the current year. It is expected that Item (2) will be repeated in approximately the same amount as above for 1940 and 1941, after which it will continue annually at approximately $3,000,000.

Item (3) is a recurring item throughout the period of the program and, as previously pointed out, increases progressively until a peak of approximately $300,000,000 per year has been reached, with an average annual expenditure of close to $225,000,000 for the assumed ten-year period.

The estimated $225,000,000, it must be borne in mind, is the total annual expenditure for Navy ship construction by government and private yards. The private yards will undoubtedly find it necessary to rehabilitate shops and equipment to some degree, the same as the Navy Yards, in which case amounts similar to Items (1) and (2) will find their way out of the private yards' portion of the $225,000,000 into shop construction awards and machine tool purchases.

Indirectly, all industries profit in some measure from these expenditures, whether for material or labor. However, the direct benefits to the mechanical industries come from the material portion of the whole, which for the purpose at hand, may be approximated as follows:

For Item 1, 30% of	$ 39,000,000	=	$11,700,000
For Item 2, 90% of	8,200,000	=	7,380,000
For Item 3, 30% of	154,000,000	=	46,200,000
			$65,280,000

Considered from the point of view of the mechanical industries as a whole, $65,280,000 is just a medium-size order. However, this is an order that is to be repeated in approximately the same amount each year for the duration of the building program, and is therefore of considerable importance.

Individual industries specializing in marine and naval equipment stand to profit materially. Loose and hand tools, and portable power tools will come in for a goodly share. These increase in proportion to the increase in workmen. Navy annual purchases in these two classes now approximate $3,200,000, and at the peak load of the program should exceed $7,000,000. Purchases by private shipbuilders as a result of the Navy building program should add approximately equal amounts. The machine tool industry and builders of other shop equipment should benefit considerably.

REAR-ADMIRAL H. G. BOWEN

As outlined, the expenditure for actual shop equipment in Navy Yards should be as follows:

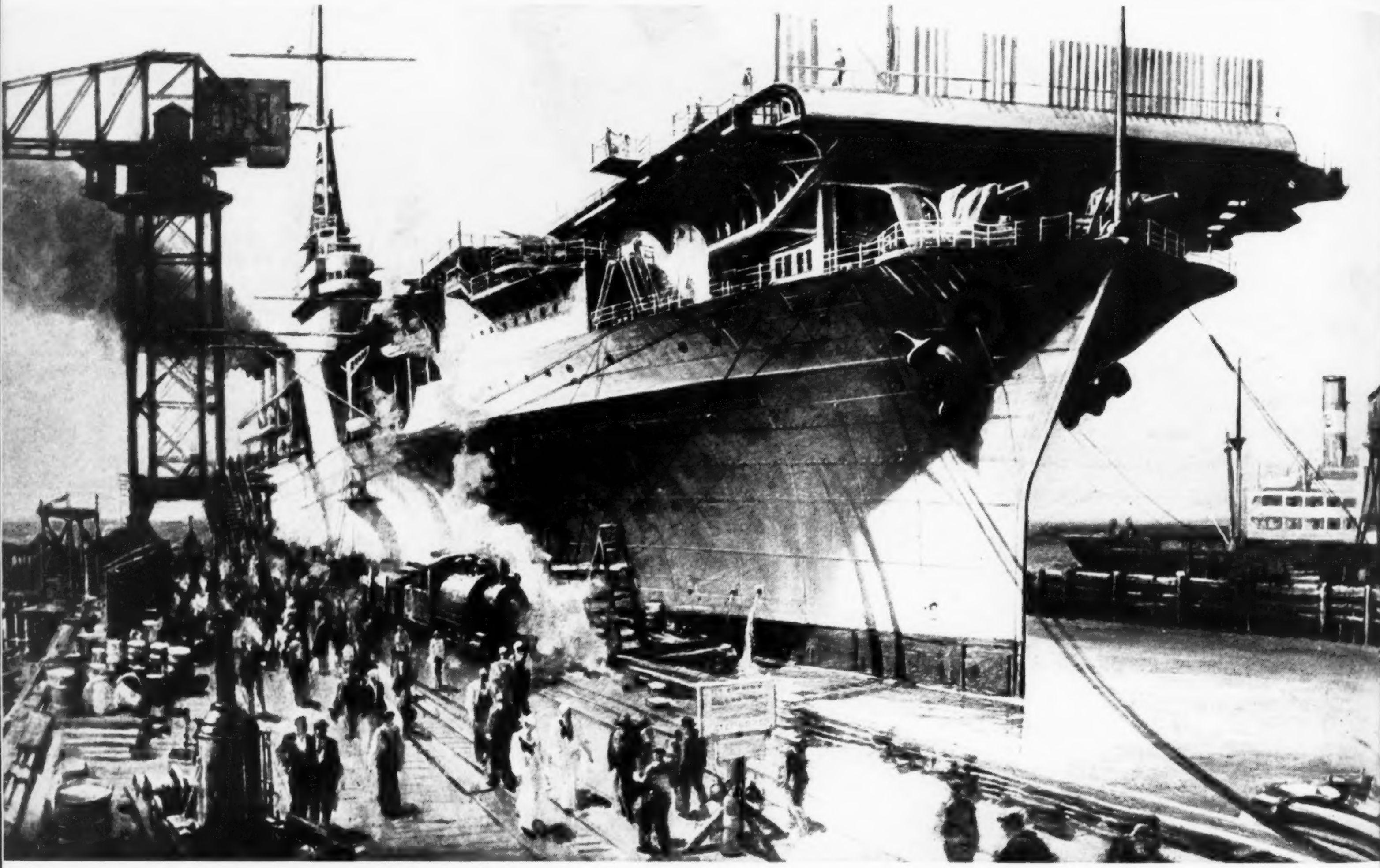
1939	$7,380,000	(actual)
1940-41......	14,760,000	(approximate)
1942-48......	21,000,000	(approximate)
Total	$43,140,000	

In addition to shop equipment for the Navy Yards, the ships being built will also require a certain amount of equipment for repair work. Approximately $5,500,000 will be spent on shop equipment for the ships themselves.

If we assume that private shipbuilding concerns spend an amount on their yards equal to that contemplated by the Navy, the machine tool and other shop equipment industries will benefit from the Navy building program to the extent of approximately $92,000,000 over the period of ten years.

Based on Navy accounting, approximately 65 per cent of the expenditures for shop equipment is for machine tools proper and the remainder for plant appliances, foundry equipment, welding sets, hammers, presses, furnaces, wood-working tools, etc. (not including weight-handling equipment such as cranes). Applying the 65 per cent measure to the annual expenditure of $9,200,000, the machine tool portion is $6,000,000. Such an amount should help the machine tool industry materially.

American Shipbuilding Reaches Highest



By CHARLES O. HERB

AMERICAN shipbuilding is at its peacetime high. The combined volume of merchant ships and United States naval vessels now on order or under actual construction is close to 750,000 tons. Impressive as this figure appears, it represents merely the start of a long-term program of the Maritime Commission for the replacement of 500 merchant vessels which will involve an expenditure of approximately one and a quarter billion dollars during the next ten years. In addition to this contemplated expansion of the merchant marine is the huge building program in prospect by the United States Navy Department, which is outlined in the preceding article by Rear-Admiral H. G. Bowen.

Ships of today, whether war vessels, ocean liners, or freighters, are about 99 per cent metal. The huge shipbuilding programs are therefore of great significance to the metal-producing and machine-building industries. Thousands upon thousands of tons of steel will be required, as well as a vast amount of labor to transform the raw material into hulls, turbines, guns, and many other items needed aboard ship. Millions of dollars will be expended to replace outmoded equipment in government and private shipyards.

In view of these opportunities confronting the mechanical industries, MACHINERY is devoting this number to American shipbuilding. The present article describes shipbuilding methods in the oldest of the shipyards, the Newport News Shipbuilding and Dry Dock Company, Newport News, Va.,

Peacetime Peak

which, since 1886, has been building warships, ocean liners, freight-carrying vessels, yachts, and even tugs. Recently the keel was laid at this Yard for the largest liner yet contracted for in the United States—the 723-foot successor to the *Leviathan.*

"Newport News" is one of the most fully equipped shipyards. It has electric furnaces for pouring the ingots that are squeezed into propeller shafts and other large or small forgings; foundries for producing brass, iron, and steel castings; plate punching and bending shops; machine shops; a galvanizing plant with one of the largest tanks in this country, and so on. Even acetylene and oxygen are produced for use by cutting torches, and there is a plant for making the usual marine paints.

There are eight shipways, two of them large enough for the construction of ships as long as 1000 feet from bow to stern and up to 105 feet beam. Two freighters can be constructed on one of these ways at a time. There are also three graving docks for the repairing of vessels. Shipways, dry-docks, and piers extend along the historic James River for approximately a mile and a quarter.

Shipbuilding requires the transportation of a vast amount of raw materials and finished units to and from the different shops and to the ships being constructed. Various types of cranes are therefore in evidence everywhere, some of them on gigantic structures over a hundred feet above the ground. In Fig. 1 is seen a double cantilever crane which extends over two shipways, and in Fig. 2 a hammer-head crane which can be used to swing anything aboard ship weighing up to 120 tons. There is also a rotating pier crane for handling turret assemblies, turbines, etc., weighing up to 150 tons.

In Fig. 3 is shown the storage yard in front of one of the ship sheds, and in the distance may be seen one of the largest shipways. In the storage yards, plates are laid out to size and to indicate where holes for rivets are to be punched. The laying out is facilitated by wooden templets, constructed in the mold loft. There is a templet for every plate or other structural piece that goes into

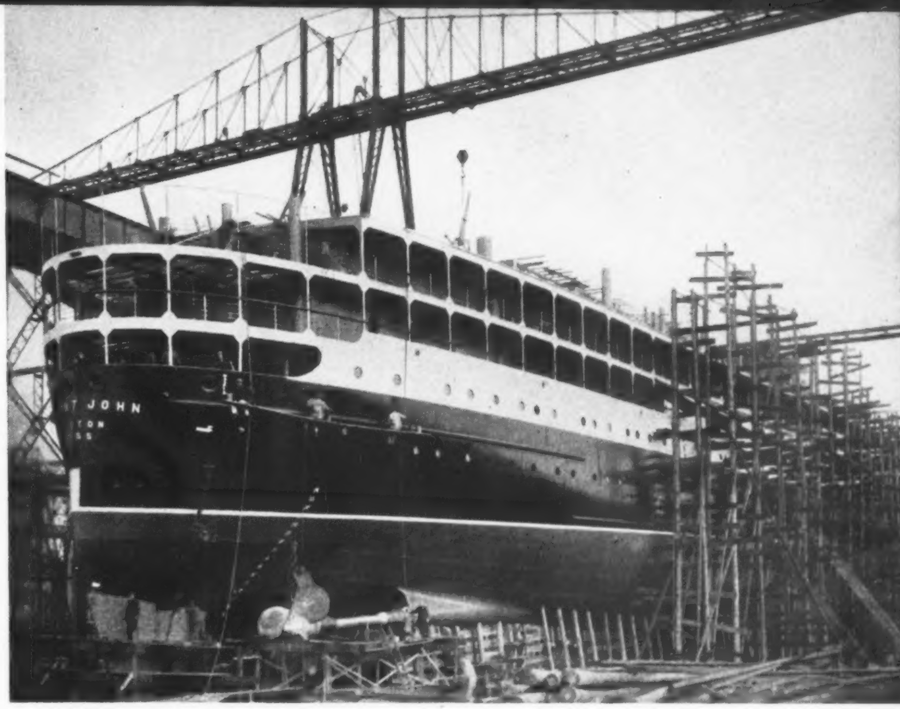


Fig. 1

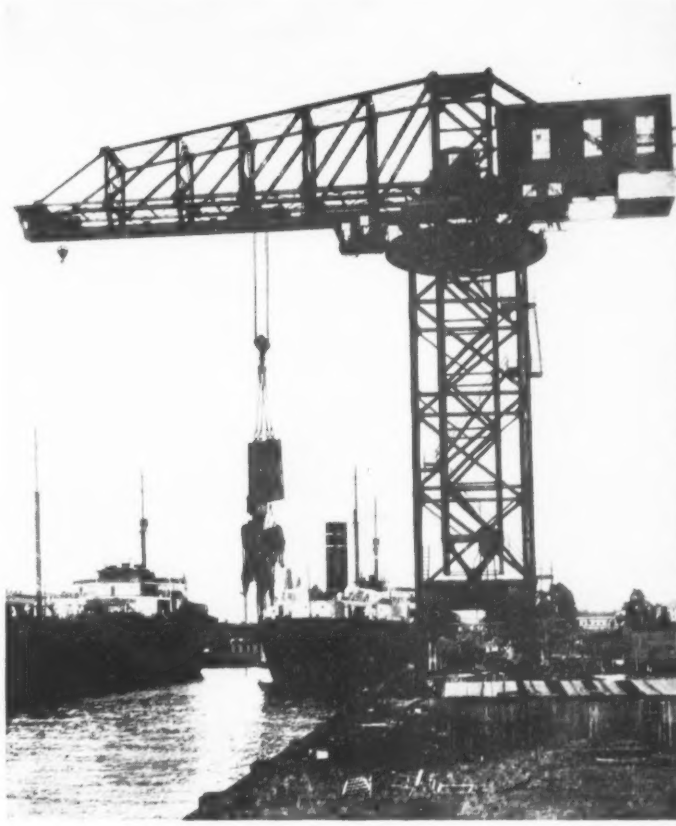


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Fig. 2

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Fig. 3

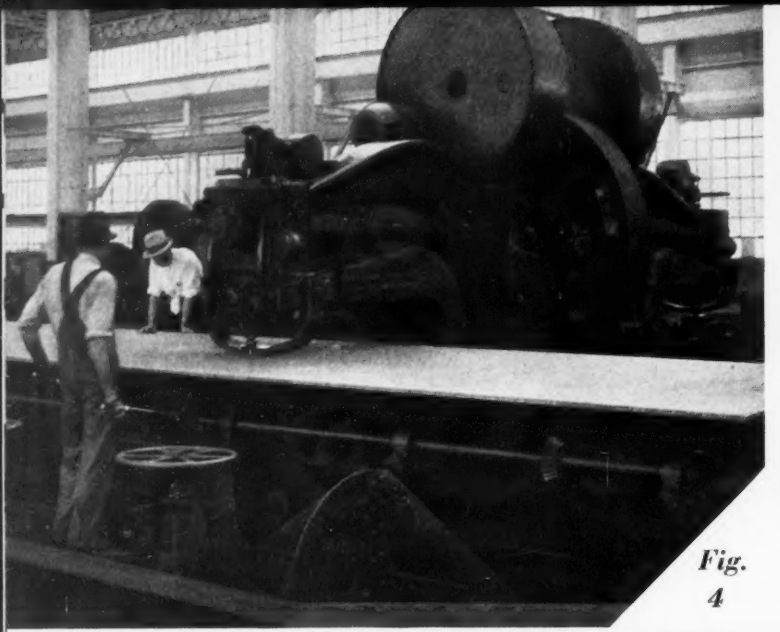


Fig. 4

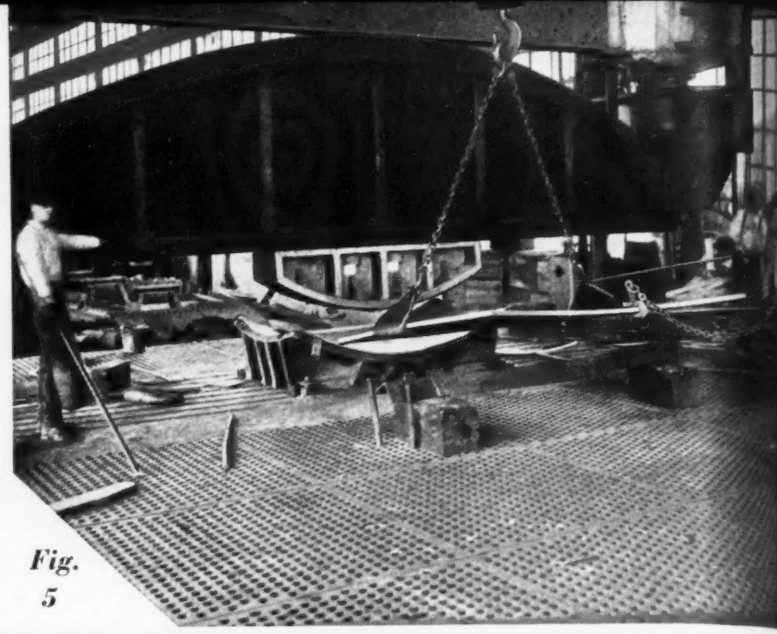


Fig. 5

★ ★ *AMERICAN SHIPBUILDING REACHES*

a ship. Templets are made not only for the complete sides of a hull, but also for cross-sections every 4 feet apart on a battleship, or every 21 inches apart on a smaller vessel, such as a destroyer. Without these full-size templets or forms, it would be virtually impossible to obtain the correct contour of a vessel.

After the plates have been laid out, they are carried by cranes into the ship sheds, where they are sheared or burned to size and then punched by double-end machines such as illustrated in Fig. 4. These machines are fitted with tables that support the plate on rollers. Two sets of the rollers are power-driven for feeding the plate longitudinally past the punch, in order to locate each prick mark under the punch. In addition, the entire table unit can be moved in and out relative to the machine. The man at the front of the table operates levers to adjust the plate as required. Holes up to 1 1/8 inches in diameter can be punched through plates 1 inch thick by the Cleveland punching machine shown.

The plates are rolled to the required shapes by means of horizontal or vertical bending rolls. One of the horizontal rolls has a span of 32 feet between the housings and capacity for bending plates up to 1 1/4 inches thick. The keel-bender shown in Fig. 5 is equipped with dies for shaping plates either hot or cold to the required contours. This press is hydraulically actuated and has a rating of 600 tons. The span is 30 feet. Another hydraulic press of 1000 tons capacity is used for forming water-tight doors, fenders, docking keels, etc.

The edges of the plates are planed and scarfed by machines built by William Sellers & Co., after which the plates are carried by cranes to the shipways for riveting or welding into ship structures. An interesting feature of the welding facilities is that the electrical current for welding purposes is converted in a separate building adjacent to the power house and delivered to fifty or more resister units which are located on a platform adjacent to the shipways. Each of these units has two leads for delivering current to welding machines used either on the outside or within a ship. The voltage delivered by any unit can be varied to meet the requirements.

Big welded structures, such as gun foundations and condenser shells, must be annealed in order to relieve the stresses produced by welding. Such structures are too large to be handled by ordinary means, and so they are placed on an oven foundation fitted with burners for oil, after which a big housing is lifted by a crane and lowered over the structures. This housing is 36 feet long by 24 feet wide by 15 feet high inside and weighs almost 50 tons. It is used in stress relieving operations at temperatures up to 1250 degrees F.

Riveting operations within the ship hulls are

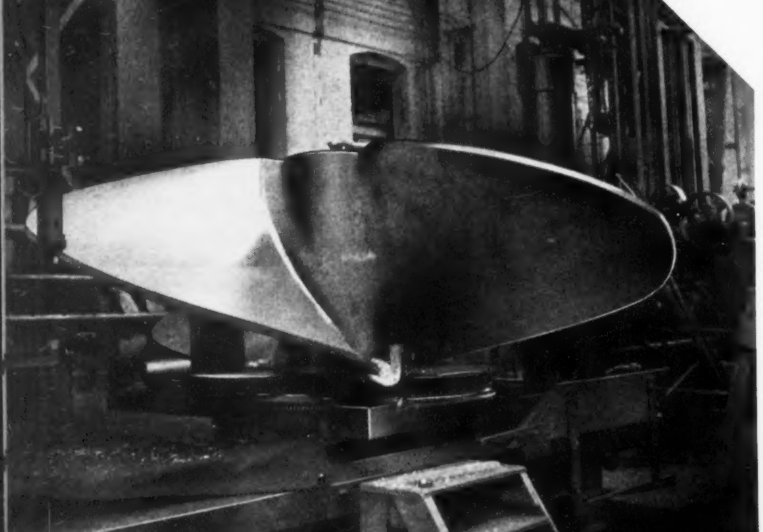


Fig. 6

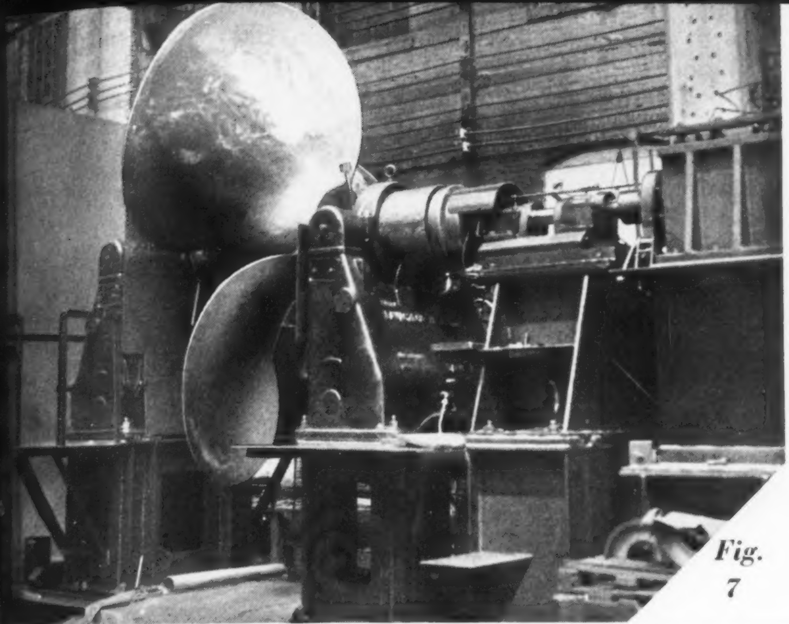


Fig. 7

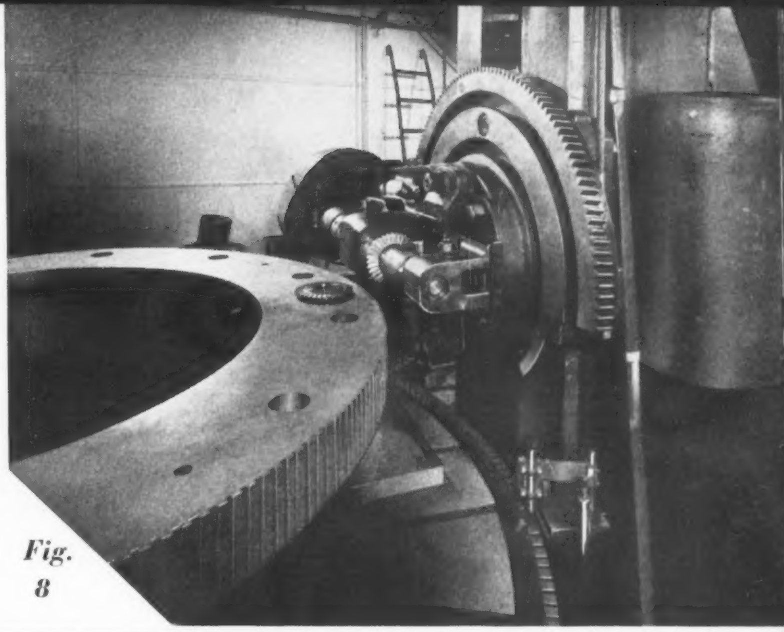


Fig. 8

performed mainly with portable air-driven tools. Bulldozers are used throughout the Yard and shops for riveting structural assemblies prior to installing them on board ship.

Both large and small machine tools are needed for finishing the great number of castings and forgings required in the building of ships. The machining of a propeller approximately 12 feet in diameter is shown in Fig. 6. This operation is performed on an open-side planer equipped with a fixture which is indexed at each return stroke of the machine table. The cutting tool is lined up with the center of the fixture and propeller hub at the beginning of the operation, and is fed down at each return stroke of the table in synchronism with the indexing of the propeller. In this way, the front or leading face of the propeller blades is machined to a true helix of the required angle.

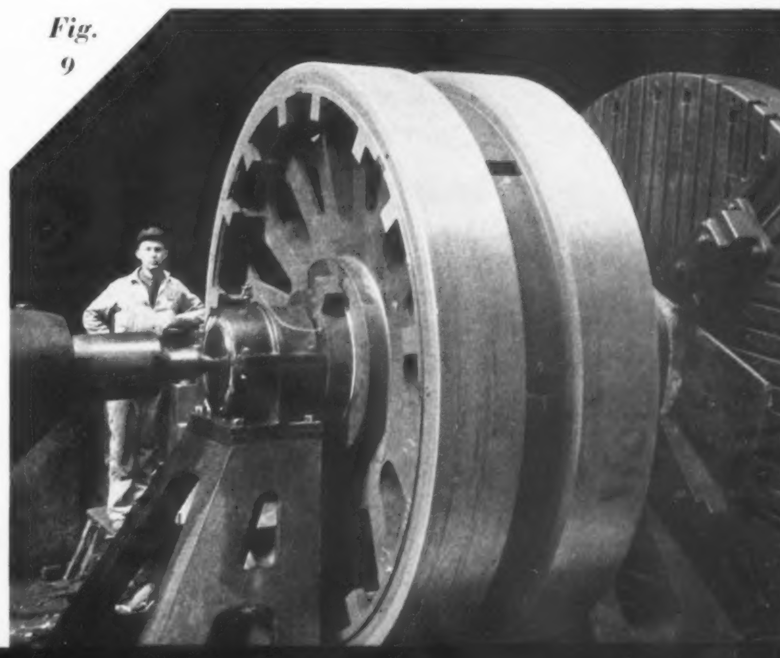
Indexing is effected through a large worm-wheel mounted near the bottom of the fixture and a worm which is actuated through reduction gearing each time that a roller passes up the incline of a cam attached to the right-hand end of the bed, as seen in the illustration. As much as 1 1/4 inches of stock is removed in a series of roughing cuts, 1/4 inch at a time. The finishing cut is taken at a depth of 1/32 inch.

The back or driving side of the propeller blades is not a true helix, the blade gradually decreasing in thickness from the hub to the edge. To determine the contour of the back side, the front face of every blade is scribed with chalk both radially and axially every 6 or 8 inches, depending upon the size of the propeller. The desired thickness at each intersection of the chalked lines is then marked on the propeller, after which the back face is chipped off and ground smooth by means of portable hand tools. The thicknesses are checked with long calipers.

Scribing is performed by attaching a rod in the center of the propeller, on which is mounted a straightedge long enough to extend horizontally the full radius of the propeller. A vertical bar holding a stick of chalk at the lower end is then slidably mounted on the straightedge. With this arrangement, a line can be scribed horizontally from the hub to the edge of the propeller blades, and radial lines can be scribed around the blade by merely swinging the straightedge about its center. Parallel horizontal lines can be laid out by measuring from the first horizontal line and using a straightedge on the propeller face.

Dynamic balance of these big propellers, which may weigh as much as 18,000 pounds, is of utmost importance because of the vibration which would be set up in an unbalanced propeller running at speeds up to 400 revolutions per minute, as in the case of the smaller propellers. Incidentally, four propellers are customarily provided on large naval

Fig. 9



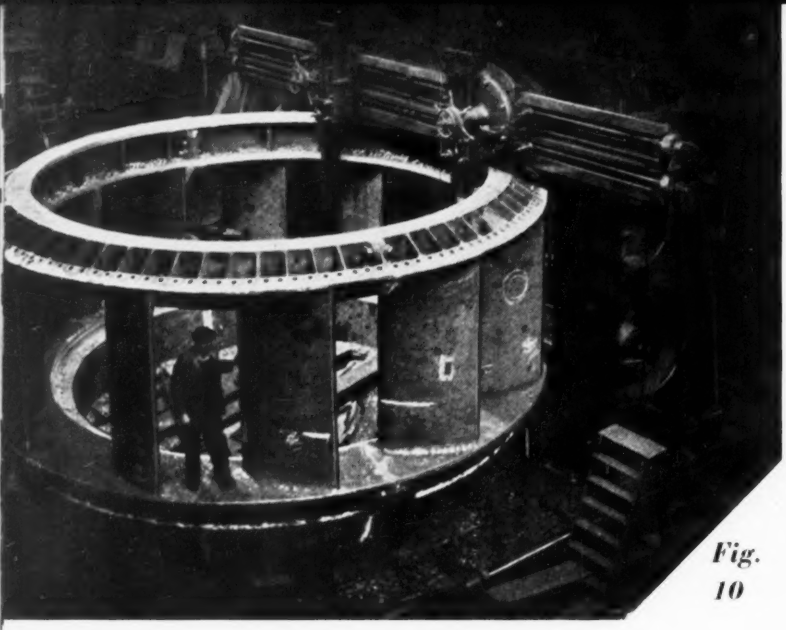


Fig. 10

ships. Dynamic balance of each propeller is determined on the machine illustrated in Fig. 7. The propeller is mounted on an arbor and in determining the unbalance at either end, the bearing on that end is permitted to float on springs, while the opposite bearing is fixed.

Propellers are revolved in this machine at speeds up to 150 revolutions per minute, and the point of maximum vibration is determined by observing the movements of an indicating lever which are recorded in ink on a moving strip of paper. The leverage of the indicator is adjustable to either 10 to 1 or 20 to 1 in order to show the actual amount of vibration greatly exaggerated. Before the inspector passes a propeller, the record of the chart must be virtually a straight line, indicating that the vibration is not more than 0.002 or 0.003 inch.

The amount and location of unbalance in a propeller are determined by a weight on a clamp fastened on the propeller arbor. This clamp has a long screw on which the weight can be adjusted in and out. The clamp is adjusted around the arbor to place the weight in the radial plane of unbalance, and then the weight is adjusted along the screw until the vibration ceases. Graduations on the arbor show the angle of unbalance, and the location of the weight indicates the amount of metal that must be removed to obtain correct balance. Corrections are then made by grinding off stock from the back of the propeller blade in the plane indicated by the arbor graduations.

When one end of a propeller has been balanced, the bearing at that end is fixed and the opposite bearing is allowed to float. A reading of unbalance in the opposite end of the propeller is then made in the same manner. A propeller usually has to be checked for balance at least two or three times, and it may be necessary to grind off 100 pounds of stock in order to obtain the required dynamic balance.

Another operation of extreme importance is the cutting of the teeth in large reduction gears and pinions. The hobbing of a big gear may require two weeks, with the machine running without interruption day and night. To insure maximum accuracy of reduction gears, a new hobbing machine has recently been installed in an air-conditioned shop, located some distance from any other shop, where a uniform temperature is maintained from the start of a gear-cutting operation until the gear has been completed. The machine rests on a deep foundation of steel and concrete to eliminate vibration.

This gear-hobbing machine is shown in Fig. 8 milling the teeth around the table drive gear of the machine itself. In order to insure extreme accuracy of this gear, upon which the accuracy of all reduction gears depends, 250 buttons of German silver were inserted in holes around the table rim

Fig. 11

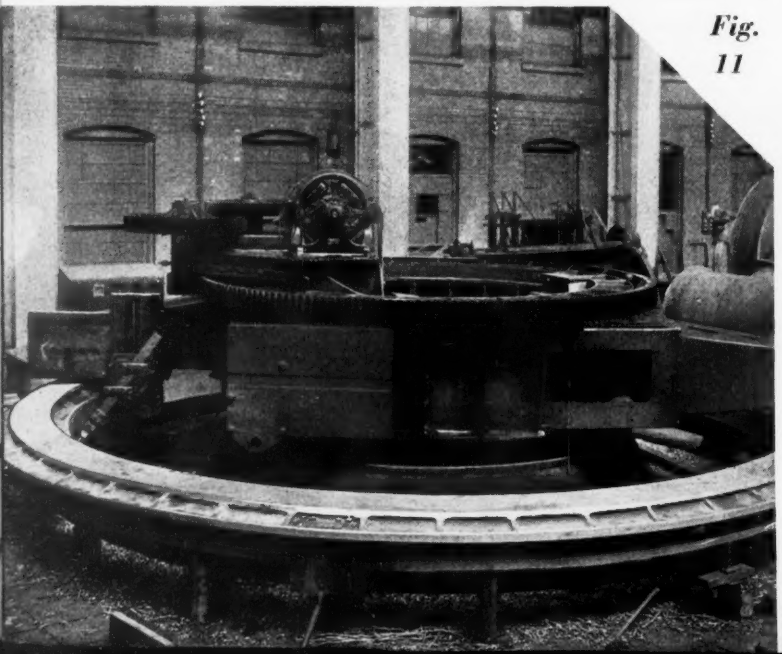
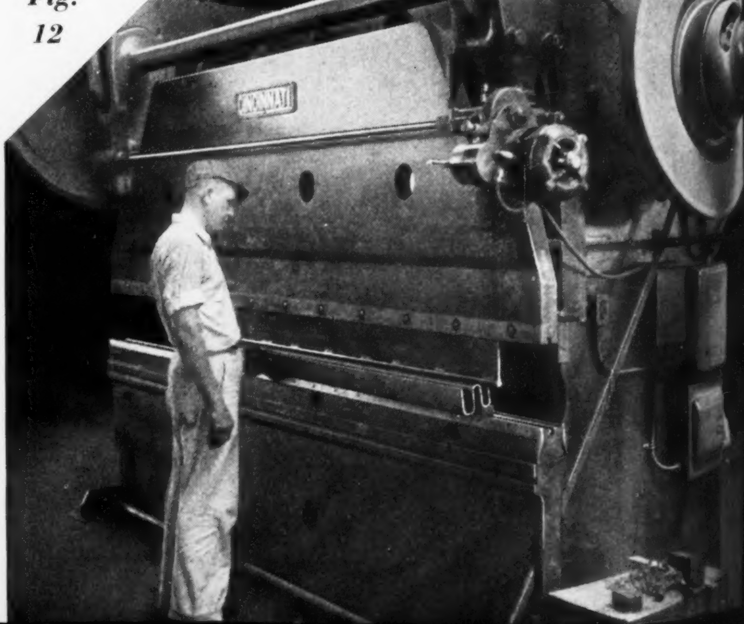


Fig. 12



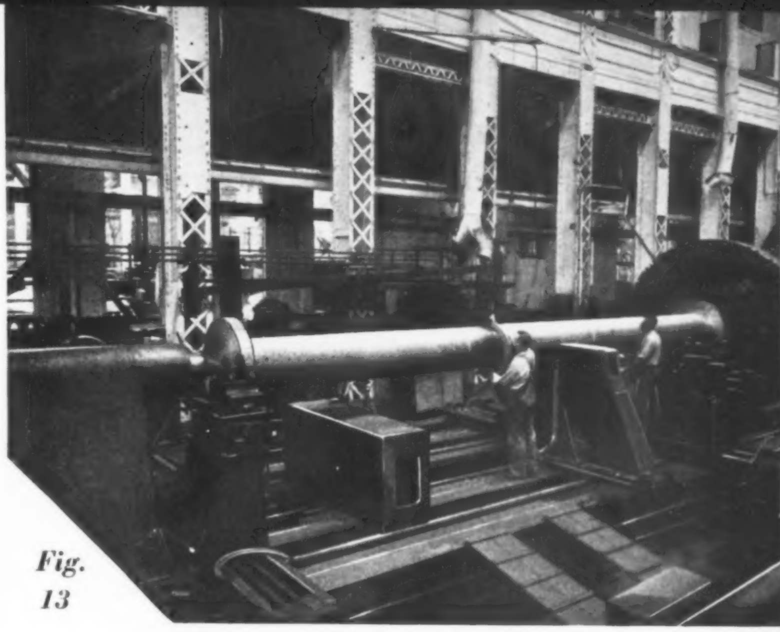


Fig. 13

and a fine line was scribed across each button toward the center of the machine for indexing purposes. The buttons were scribed by attaching a tool to the table rim in positions determined by the use of a microscope. In milling the gear, microscopes were used on opposite sides of the table as illustrated, to determine the correct indexing for each tooth.

Reduction gears range up to 11 feet in diameter and the helical teeth are cut as large as 5 diametral pitch. A lathe operation on two reduction gears prior to cutting the teeth is illustrated in Fig. 9. The lathe has a swing of 125 inches.

Other large machine tools are required for machining the driving equipment of big vessels. The machine shop, for example, has a number of big boring mills, including a Sellers 35-foot mill, from which the uprights, cross-rail, and top rail can be removed, leaving the base for machining a part that cannot be conveniently placed on the machine table because of size or weight. The machining of a hydraulic turbine speed ring on a boring mill is illustrated in Fig. 10.

A portable machine for finishing the tracks of battleship turrets is shown in Fig. 11. The turret track is mounted on a floor plate and the machine revolves within it to carry the tools around the work for turning or boring. Diameters on these large parts are held within almost unbelievably close limits.

Among the newer machines in the sheet-metal shop is a Cincinnati press brake, shown in Fig. 12 being employed for corrugating a boiler expansion joint. Sheets up to 12 feet long and 3/16 inch thick can be handled by this machine, which is equipped with a large variety of dies for bending many different parts. Another recent machine is a Federal seam-welder, shown in Fig. 14 being used for welding the front of a water-tight door to its angle-iron frame. The circular electrodes produce a series of spot welds, so closely spaced as to make one continuous water-tight weld. Spot welds can, however, be made 1 inch apart on this machine, which is used on various materials, including stainless steel, aluminum, steel, and wrought iron.

The Thomson-Gibb spot-welding machine shown in Fig. 15 is also used for a variety of parts, including ventilation ducts, locker parts, boxes, etc., made from stainless steel, aluminum, brass, and other metals. This machine is equipped with a long arbor for supporting the work, and there are various types of electrode-holders designed to facilitate the particular operation being performed.

Propeller shafts up to 70 feet long and up to 24 inches maximum diameter are finish-machined in this Yard. Fig. 13 shows a lathe operation on a propeller shaft 30 feet long.

Fig. 14

Fig. 15

Big Guns for the

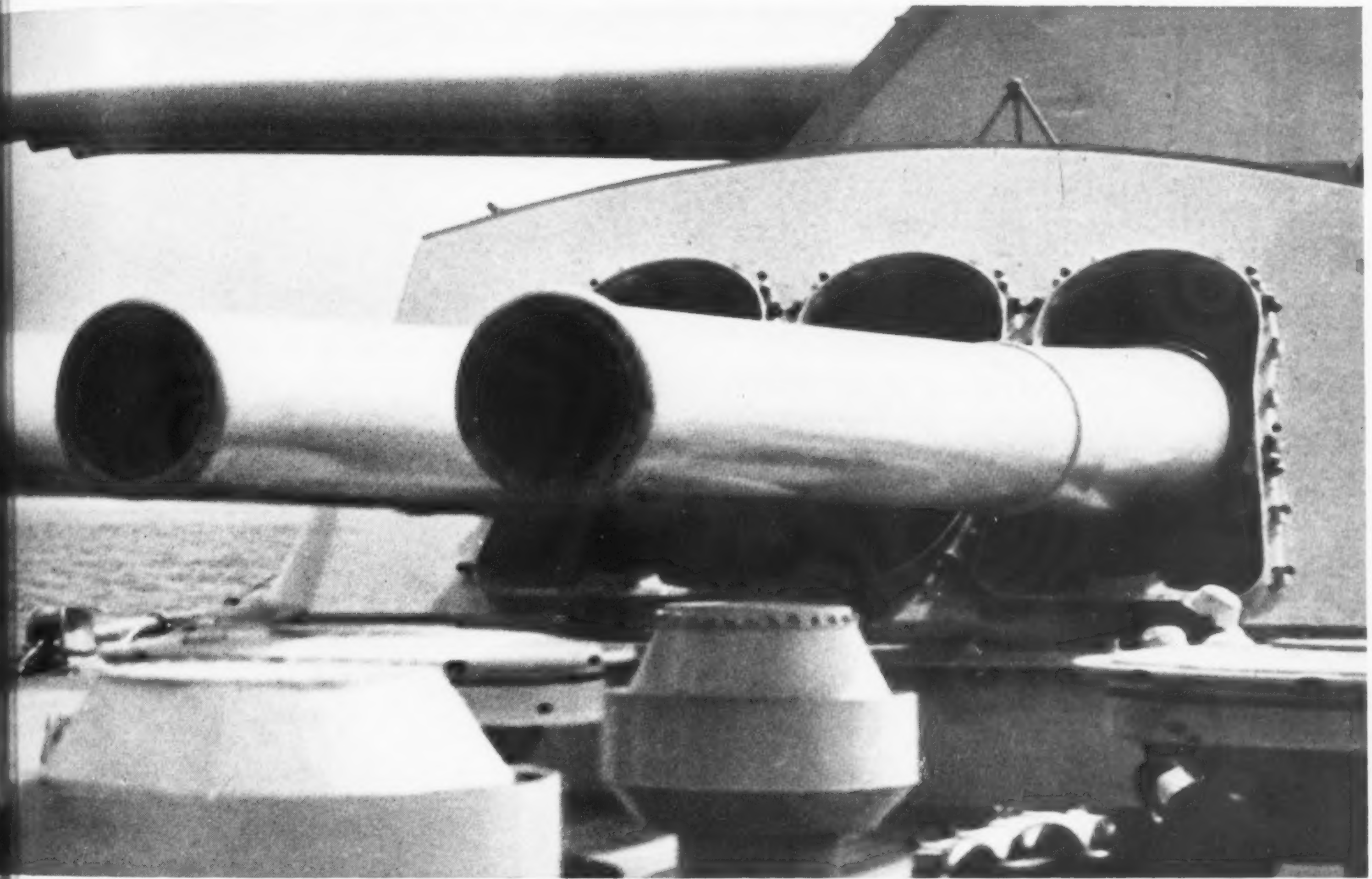
The Navy's Guns are Our "Sentinels of Security"—They Constitute Our First Line of Defense in the Event of Necessity. Here is an Article that Outlines Some of the Many Interesting Operations Involved in Producing Our Biggest Guns

By CHARLES O. HERB

GUNS capable of hurling projectiles weighing a ton or more through 15 to 20 miles of space with unerring accuracy are examples of mechanical engineering and craftsmanship of the highest order. Such a gun must withstand a terrific internal pressure during discharge. Despite the large diameters, which run as great as 5 feet on 16-inch guns, close limits must be maintained on all sliding surfaces.

Most of the guns for United States warships are constructed at the Washington Navy Yard, which has a civilian personnel of approximately 8000 at the present time. All but the largest forgings are produced here from ingots poured from electric furnaces; the foundry turns out all the iron, steel, and bronze castings required; and the various machine shops perform the highly accurate operations

United States Navy ★ ★



necessary in building up the guns themselves, the gun sights, and the gun mounts.

During the last few years the shops of the Washington Navy Yard have been supplied with a large number of modern machine tools which have greatly facilitated the production of naval guns, and considerable additional equipment will be purchased within the coming months. Typical operations in this highly interesting gun factory are shown in this article.

An important requirement in gun design is that the gun must be much stronger at the powder chamber than at the muzzle end, because the internal pressure decreases as the projectile advances along the bore. For this reason large guns are built up with a tube and liner that extend the full length, from the powder chamber to the muzzle end—52 1/2 feet on a 14-inch 45-caliber gun—and a series of cylindrical "hoops" that extend various distances from the breech end. On the size gun mentioned, there are six of these hoops.

The tube and hoops are turned and bored to predetermined diameters within 0.001 inch, the bore of each member being smaller than the external diameter of the part that it fits, so that it is assembled by shrinkage. For the assembly of the various hoops, tube and liner, a cylindrical furnace with electrical heating units is erected in a pit 100 feet deep. The outer part to be assembled is then heated in this furnace until it has expanded sufficiently so that the next inner hoop or the tube, as the case may be, can be readily slipped into it, the unheated member being lowered from an overhead crane. Water is then discharged around the assembly to

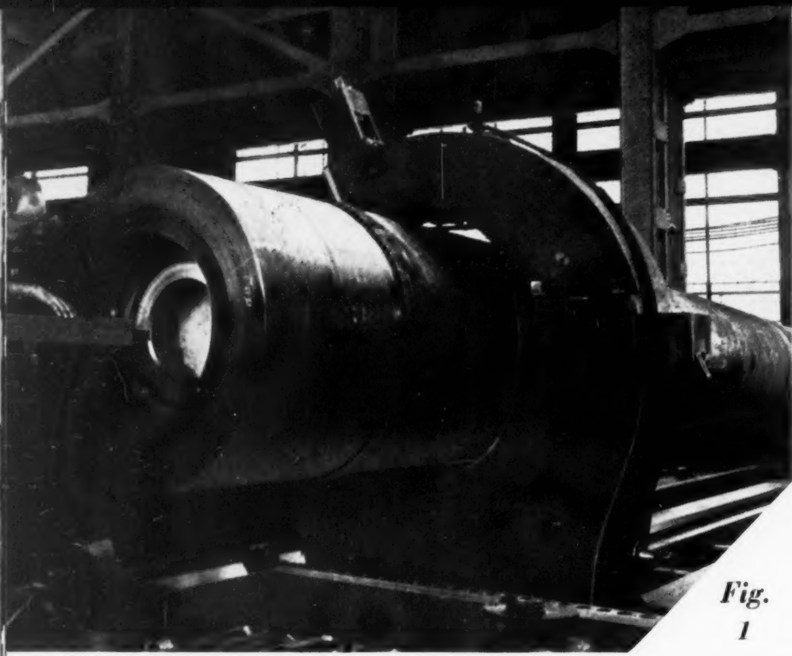


Fig. 1

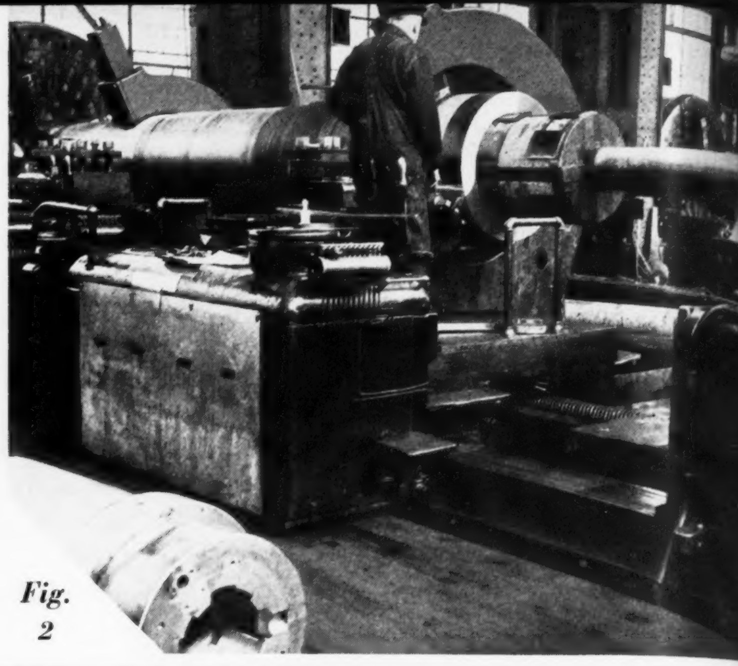


Fig. 2

★ ★ BIG GUNS FOR THE

shrink the outer hoop securely in place. Temperatures up to 800 degrees F. are employed in this operation, and it takes over 21 hours to obtain the required expansion of the tube for a 14-inch gun.

The liner is the last member to be assembled, after which the gun is finish-bored and "chambered." Then the gun is finish-turned, rifled, and honed. Fig. 1 shows typical lathe cuts being taken in the chamber end of a huge completely built-up gun which is supported in three big steadyrests as it rotates. The Niles lathe in which this operation is performed is big enough to handle the Navy's largest forgings for gun assemblies.

In boring the shorter hoops for a gun, a conventional boring-bar is used, but in the case of the long hoops, tube, and liner, there would be too much spring in a bar of conventional design 40 to 60 feet in length, and so use is made of "packed bits." These packed bits, as may be seen in Fig. 2, consist of built-up cylinders of oak with an iron internal frame and have two boring tools 180 degrees apart. The wooden cylinder is several thousandths of an inch larger in diameter than the hole to be bored, and as it is forced along the machined bore immediately in back of the tools, it holds them rigid and insures a straight hole. After every few feet of boring, the bit is withdrawn and the accuracy of the bore diameter is checked by means of a star gage mounted on the end of a long graduated tube. Readings of bore diameter are made at the handle end of this tube, which projects from the gun. Two roughing and two finishing cuts are generally taken on each bore.

Surface finish is of utmost importance and, there-

Fig. 3

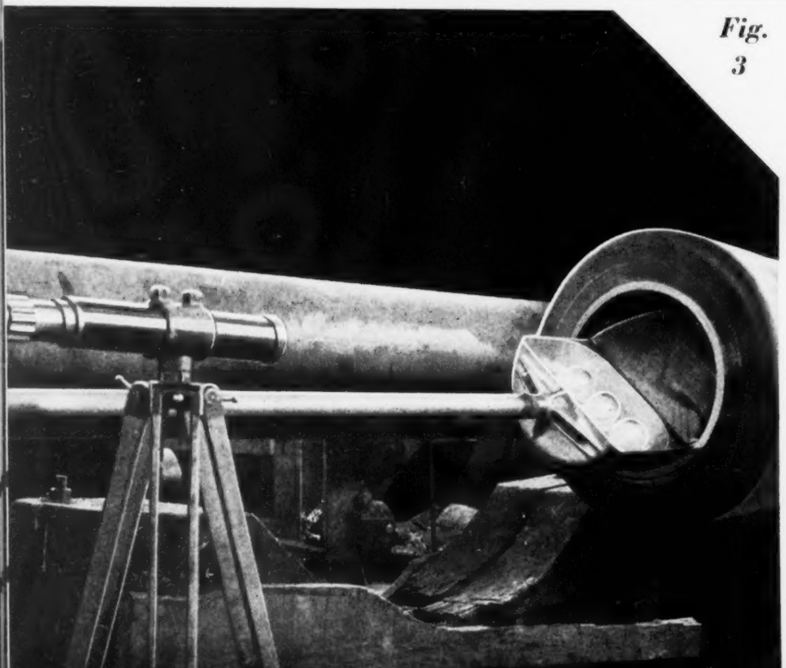
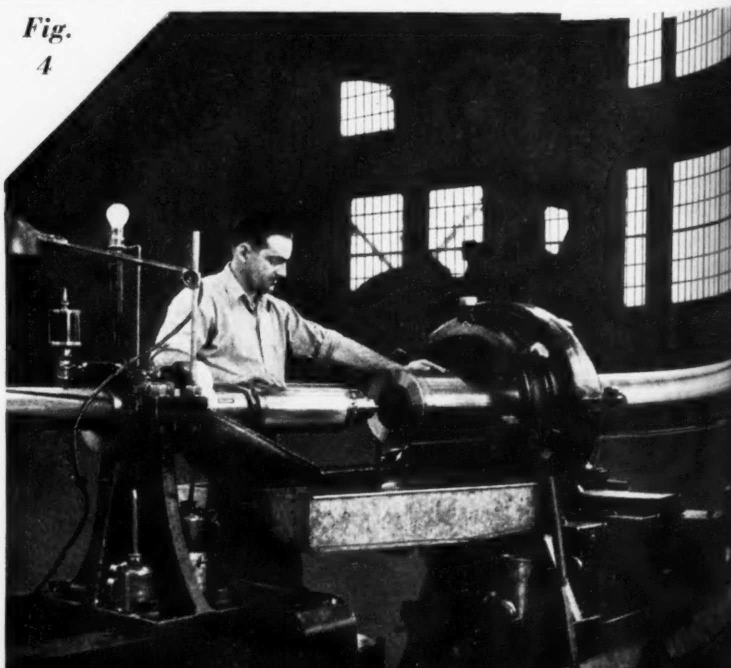


Fig. 4



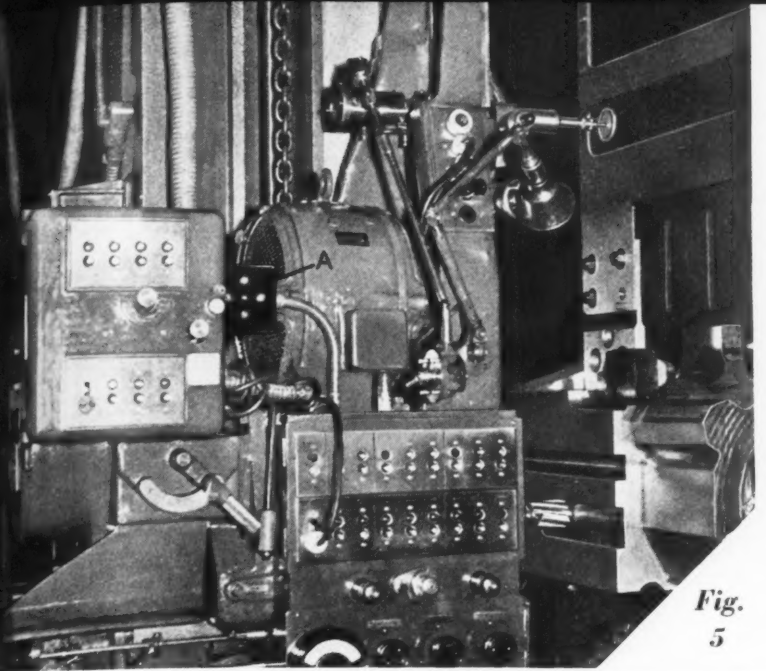


Fig. 5

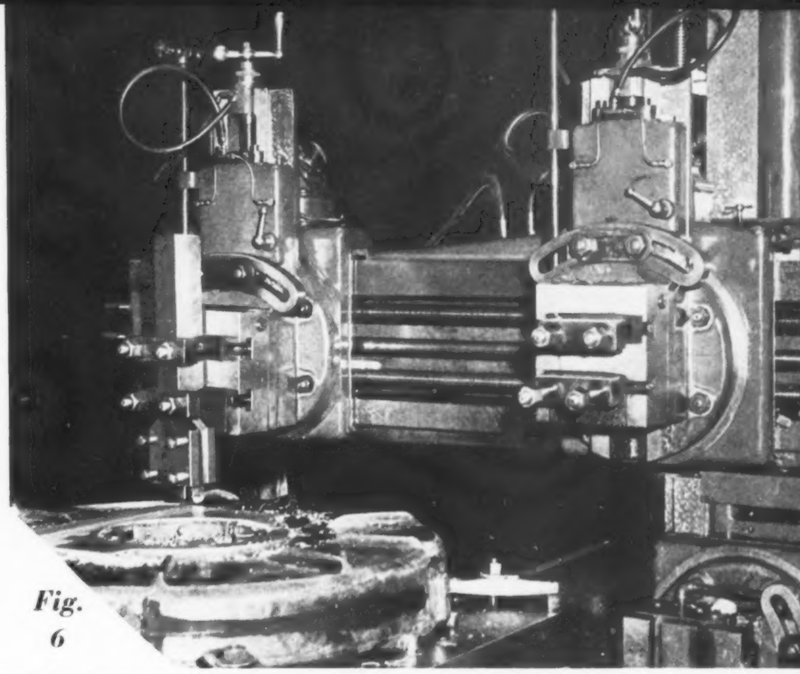


Fig. 6

fore, every square inch of bore surface is observed by means of a unique device called a "bore searcher." This device, which is shown in Fig. 3, consists essentially of an aluminum head attached to the end of a long handle. The head is fitted with three 100-watt incandescent electric lamps and has a mirror inclined at an angle of 45 degrees. The lamps light up the bore as the searcher is moved along, and the mirror reflects the finish of the surface back to the inspector, who looks into the mirror from the end of the gun by means of a telescope. The aluminum head of the bore searcher is slightly smaller in diameter than the gun bore, so that it can be conveniently swiveled in the bore to observe the entire circumference, as well as length.

Rifling is performed by means of tools mounted on the front end of a head such as shown in Fig. 4. This head is attached to a long bar in which there is a groove that engages a key for swiveling the tool-head as it is advanced along the bore. Thus a liner can be rifled to a uniform or changing helical angle, as required.

One-half of the rifle grooves are cut at a time, 0.001 to 0.0015 inch of stock being shaved off by every tool at each pass of the rifling head. From 100 to 150 passes are necessary to complete one-half of the grooves in a big gun. When these grooves have been finished, the tools are reset for cutting the remaining grooves in a similar number of passes.

Keller automatic tool-room machines are used for a number of profiling operations in the breech-mechanism and torpedo-tube shops. These machines are fitted with an electrical device, as shown at *A*,

Fig. 7

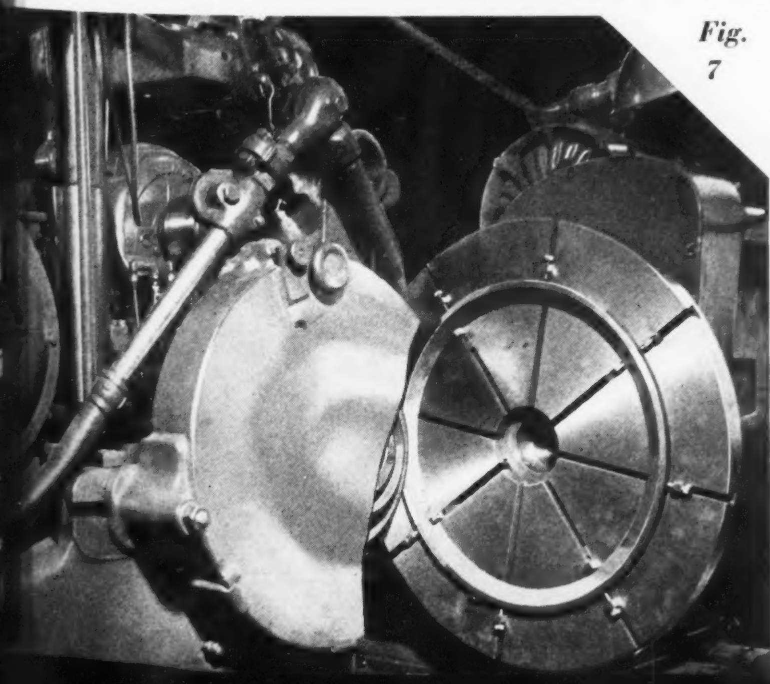
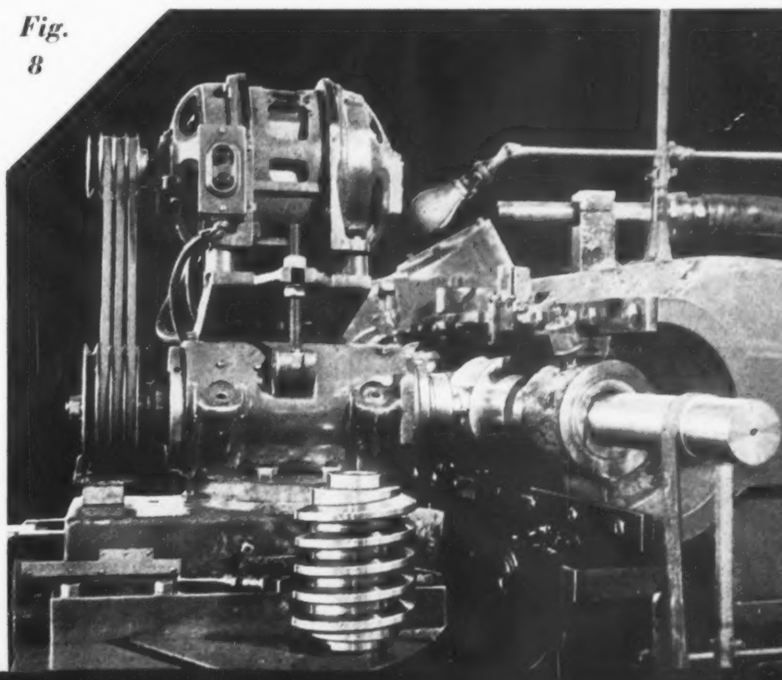


Fig. 8



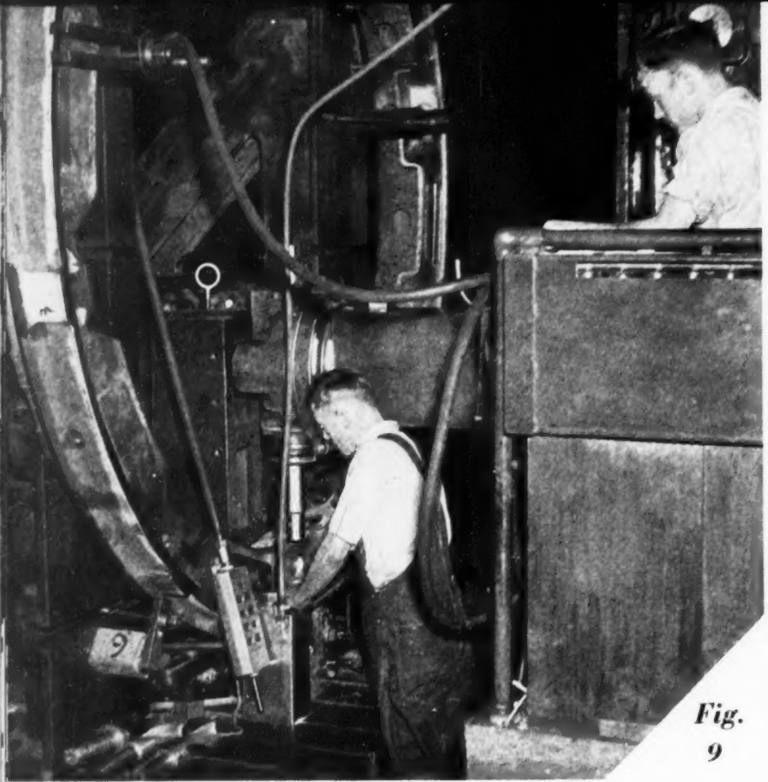


Fig. 9

Fig. 5, which has four lamps that light up to indicate instantly any change in the direction of cutter movement. Different lights indicate upward, downward, forward, and return movements. The device therefore eliminates all guesswork as to the direction of cutter movements.

In a number of operations, as in the one illustrated, a master plate is bolted directly to locating surfaces previously machined on the work, and a templet is mounted on this master plate for guiding the tracer that controls the cutter movements. This method of attaching the templet to the work rather than to the regular fixture provided on the machine, saves a great deal of set-up time. In operations on the larger parts of breech mechanisms, limits of plus or minus 0.005 inch are the general practice for practically all dimensions.

Rockford Hy-Draulic planers are used for various operations in the torpedo-tube and miscellaneous machine shops. In Fig. 6 an open-side machine of this classification equipped with three heads and a pendent control is shown performing a typical operation on a steel casting.

Rings of the type illustrated in Fig. 7, of various diameters, must be ground to extremely close limits on both faces, the beveled surface, and the periphery. All of these operations are performed in several set-ups on Landis universal grinding machines of the type illustrated. The table is fed longitudinally by hydraulic power for grinding the flat sides and the bevel.

Hourglass worms and worm-wheels are cut on the Gould & Eberhardt machine illustrated in Fig. 8. Form cutters resembling end-mills are used, which revolve as they are fed along the rotating work. Threads are cut to shape, circular pitch, and pitch diameter within an accuracy of 0.001 inch. The cutter seen in use is turning the "hourglass" surface prior to cutting the thread.

The huge Morton draw-cut shaper illustrated in Fig. 9 is used for performing a variety of operations, such as shaping, boring, drilling, milling and slotting, in a single set-up of heavy work. This machine has a stroke of 84 inches. The illustration shows a hole being bored in a large steel casting. The operator controls the machine close to the tool by means of a pendent switch.

Profiling and die-sinking operations on parts ranging in size up to 36 inches long by 22 inches wide by 16 inches thick are performed on the Cincinnati Hydro-Diematic milling machine shown in Fig. 10. The table is hydraulically actuated in the longitudinal direction, and the cutter-head is hy-

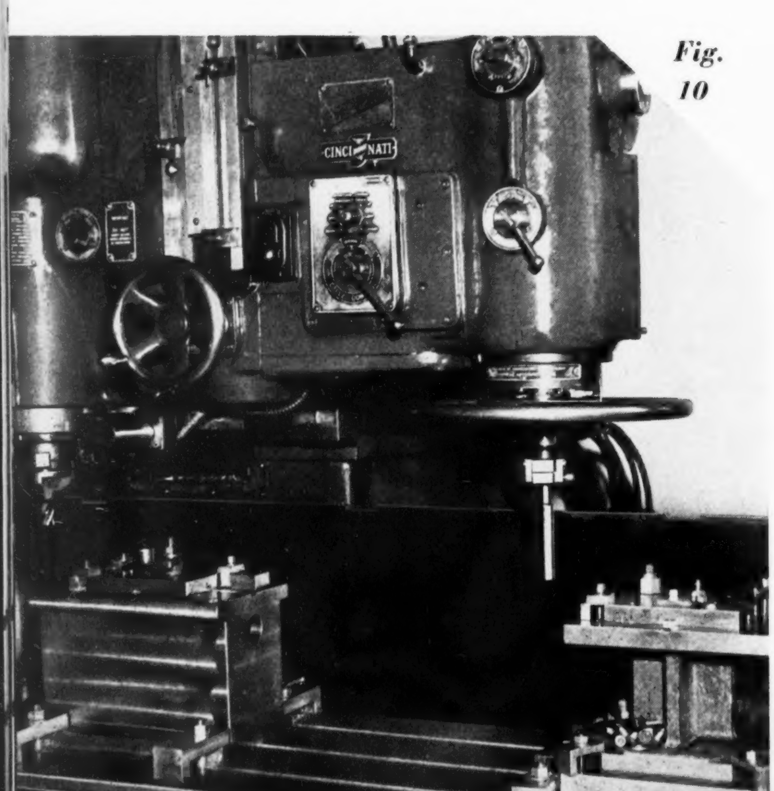


Fig. 10

draulically actuated crosswise and vertically. These three feed motions are automatically controlled through a hydraulic device by a tracer finger which bears lightly against the contour of the master at the right. The work is machined to the shape of the master within an accuracy of plus or minus 0.002 inch.

Planer type milling machines are used extensively in the breech-mechanism shop. In Fig. 11 an Ingersoll machine of this type is shown equipped with an indexing jig that enables surfaces to be machined to twelve different angles with one set-up of the work. The work is positioned for each cut by merely turning a crank-handle and inserting a locking pin in the proper locating hole of the index-plate. Dial indicators mounted on this machine insure accurate settings of the cutter-head and table.

Horizontal boring, drilling, and milling machines are also used extensively in the production of gun parts. In Fig. 12 is shown a Giddings & Lewis machine of this type milling a locating keyway in a gun housing; the center distance, width, and height of the keyway are machined within an accuracy of plus or minus 0.002 inch. A similar keyway has been previously milled on the opposite side of the gun housing, and it is of the utmost importance, in this operation, that the center line of these keyways be true with the bore of the gun.

Work up to a nominal diameter of 25 feet can be accommodated by a huge Betts vertical boring mill. Even on such large parts the diameters are often held to limits of plus or minus 0.001 inch.

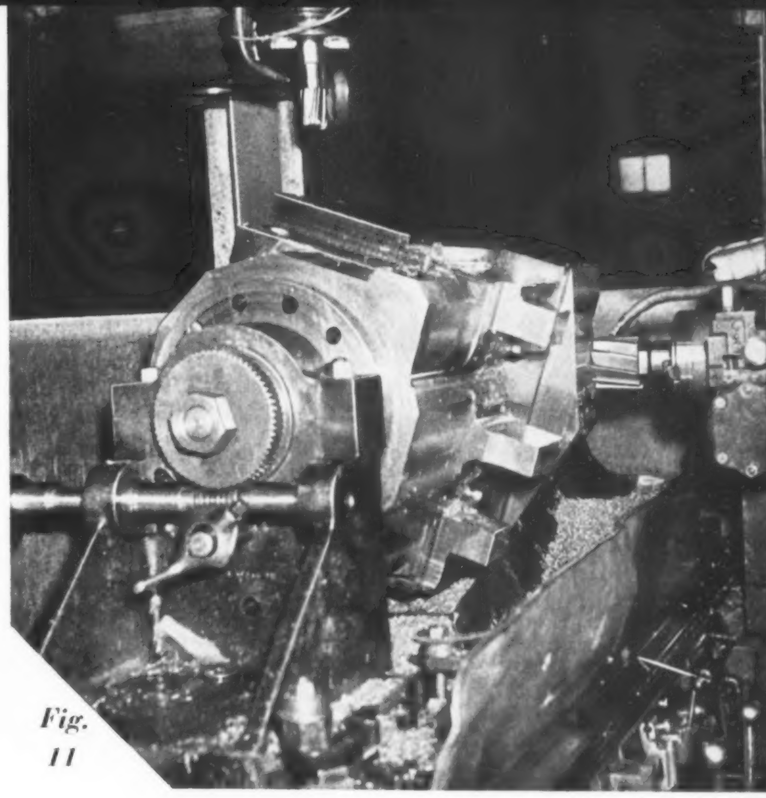
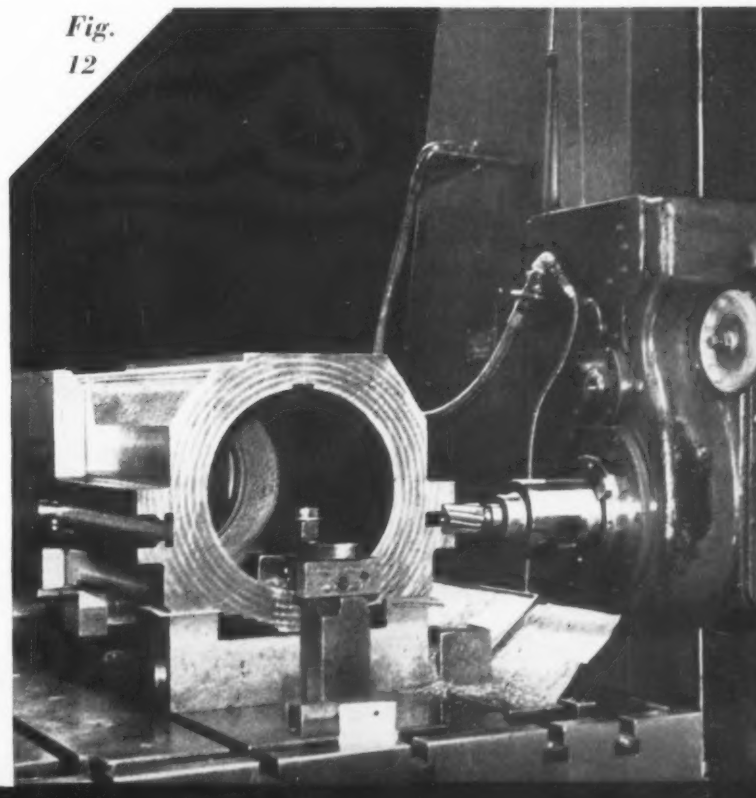


Fig. 11

Fig. 12



Diesel Engines for Marine Service

TWO-THIRDS of the ocean-going tonnage of ships under construction the world over will be driven by Diesel engines, according to statistics compiled by Lloyd's Register of Shipping, and this has been true for the last four or five years. One of the important reasons for this large application of the Diesel engine for marine service is that 50 per cent less space is required for oil in comparison with steamships that are to cruise the same distance. In addition, the space occupied by the Diesel engine equipment is considerably less. Compared with coal-burning steamers, the fuel economy of Diesel-engine vessels is much greater and there is also a large saving in labor through the elimination of stokers for firing the boilers.

These advantages, together with others, have resulted in the universal adoption of Diesel electric drives for submarines and in the increased use of direct Diesel drives by all types of vessels. Among the large liners propelled by Diesel engines may be mentioned the *Kungsholm*, *Gripsholm*, *Britannic*, *Coolidge*, and *Pilsudski*. Oil tankers, freighters, naval supply and ammunition ships, dredges, tugboats, and even fishing boats are being driven by Diesel engines.

The Diesel Engine Division of the American Locomotive Co., Auburn, N. Y., has recently been awarded a contract to supply four main and four auxiliary engines for a large submarine tender, an order that amounts to approximately $1,700,000. This equipment will be produced in a plant that has been manufacturing Diesel engines exclusively for the last twenty-four years and steam engines for many years previous to that. Manufacturing methods to be used in building this propulsion equipment for the submarine tender will be similar to those here illustrated, which have been employed on other Diesel engines produced for ships. In Fig. 1 is shown an Alco-Sulzer two-cycle engine of 1500 brake-horsepower which was built by the concern. Four-cycle engines of McIntosh-Seymour design are also produced in the same plant.

An outstanding feature of Diesel engine manufacture is that, in spite of most parts being many times larger than similar parts of automobile engines, dimensional tolerances are as close as those customarily specified in the automotive industry. On the other hand, there are also small parts that necessitate extremely delicate workmanship as, for example, the nozzle of fuel injection pumps in which holes are drilled to a diameter of 0.006 inch.

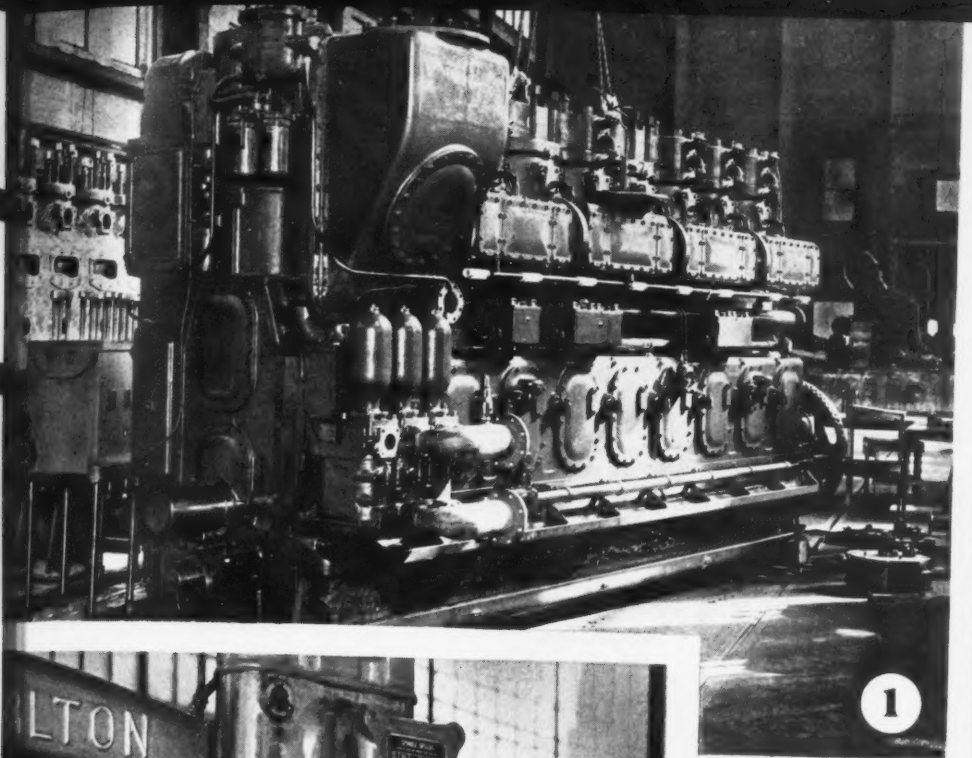
Some of the castings are so large that the machine tools have to be provided with special equipment for handling them. In Fig. 2, for example, is shown a Cincinnati-Bickford radial drilling machine equipped with a table which is, in reality, a low flat car that can be run back and forth on structural rails embedded in the floor. The casting seen on the table is an engine base.

Pistons as large as 32 inches in diameter have been made in this plant. Drain-holes for oil-scraper rings are shown being drilled in Fig. 3 through one of the smaller pistons. These holes are drilled at different angles, and to provide for this, the Carlton radial drilling machine illustrated is equipped with a tilting fixture.

Pistons are ground to specified diameters within plus 0.000 minus 0.001 inch in the Norton cylindrical grinding machine shown in Fig. 4. The parallelism of straight pistons must also be held within 0.001 inch, and there is a similar tolerance on tapered pistons. The longest piston so far produced had a length of 50 1/4 inches and was 23 inches in diameter. Pistons are made from both cast iron and aluminum.

Diesel engines are constructed with renewable cylinder liners that are assembled into holes bored in the engine frame. The number of cylinders varies from four to ten in engines built for marine service. Fig. 5 shows the boring operation on a five-cylinder frame. Four seats approximately 4 inches in width are rough- and finish-bored in each hole to a diameter of 20 inches, the operation requiring a boring-bar approximately 24 feet long by 8 inches in diameter. Two diametrically opposed cutters are used for the roughing cuts and a single cutter for finishing.

The Barrett boring machine used in this operation is equipped with a table 25 feet long and a base 45 feet long, which extend at right angles to the machine spindle so that the engine base can be indexed from bore to bore without changing its set-up on the table. The boring-bar is held rigidly by the use of an outboard support.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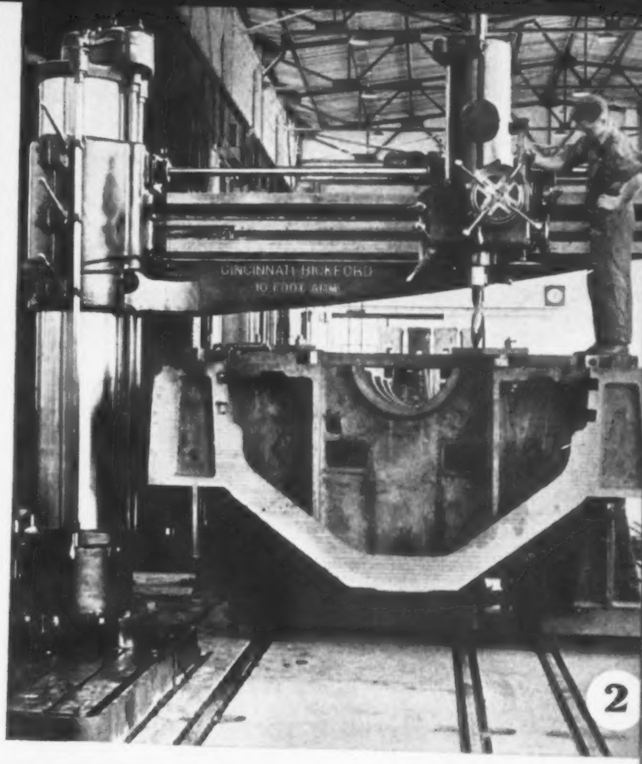
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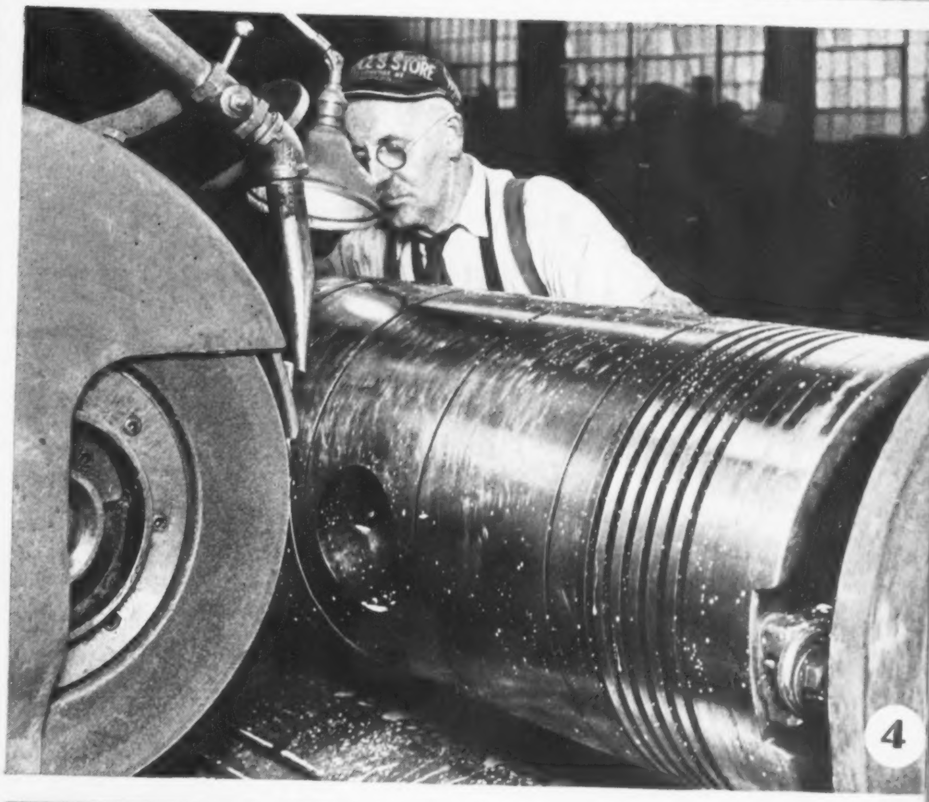
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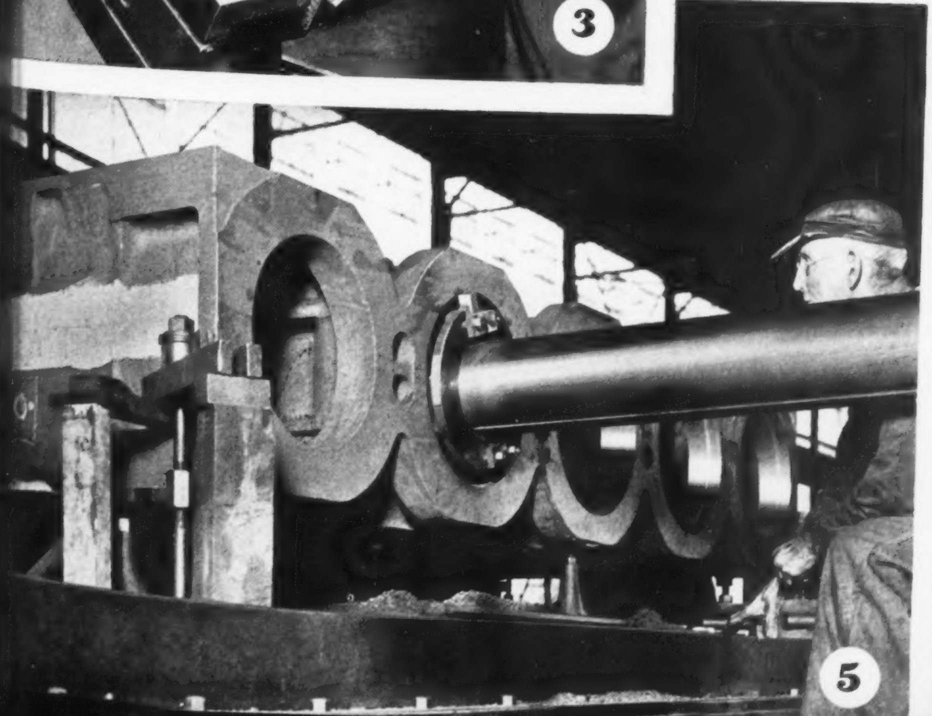
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A close-up view of a huge Moline "Hole Hog" duplex-head machine used for simultaneously boring both ends of connecting-rods is illustrated in Fig. 6. The connecting-rods range as large as 5 feet 6 inches between centers, and this dimension must be held within plus 0.000 minus 0.001 inch. The center-to-center distance of the rod shown being machined is 28 inches.

Close tolerances are also specified on the bored diameters which, in the case of the connecting-rod seen in the machine, must be from 9.250 to 9.251 inches and 6.7505 to 6.7515 inches. Approximately 2 inches of stock on the diameter is removed in roughing, semi-finishing, and finishing cuts, two diametrically opposed cutters being used in each step. The connecting-rods are forgings of unusual toughness and with a high Brinell hardness reading. The boring spindles are fed downward hydraulically, reverse automatically at the end of the cuts, and stop in the starting position. The boring heads are adjustable along the machine column.

A huge Betts planer is seen in Fig. 7 simultaneously machining a series of large columns for a six-cylinder engine. Castings up to 36 feet long, 15 feet wide, and 10 feet high can be accommodated on this machine. There are two tool-heads on the cross-rail of the machine, two side-heads, and a fifth head on a column that is located at the rear of the bed for machining surfaces that may overhang the side of the table.

Camshaft driving or timing gears are turned and bored complete on the Bullard vertical turret lathe shown in Fig. 8. Gears up to 42 inches in diameter can be handled by this machine, the gear forging seen on the table being 31 inches in diameter. Outside diameters on these gears must be held within a tolerance of 0.004 inch, and the center bore within plus 0.000 minus 0.001 inch.

Cylinder liners are accurately bored on a horizontal type of machine, and then rough- and finish-turned in a lathe before coming to the Barnes hydraulically operated honing machine shown in Fig. 9. The liners range up to 32 inches in internal diameter and up to 6 feet in length. When the liners leave the honing machine, the internal diameter must be to size within plus or minus 0.0005 inch throughout the entire length, and the bore must be concentric within 0.001 inch. A Micromatic hone is used in this operation. The honing machine has a height of approximately 34 feet, extending so high above the floor that it was found desirable to equip it with a blinking red light on top to warn crane operators of its presence.

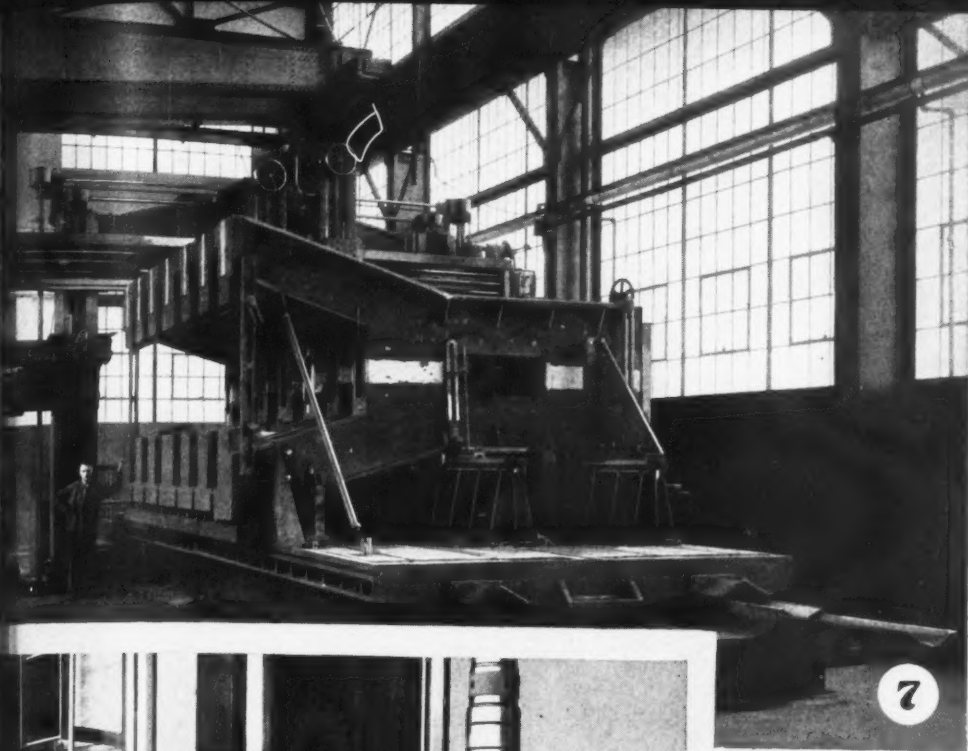
The Lees-Bradner hobbing machine shown in Fig. 10 was recently installed for cutting the helical teeth on camshaft idler gears. The bronze gear seen in the machine, which is typical, must be between 10.768 and 10.770 inches in outside diameter. This gear has fifty teeth, of 5 normal diametral pitch and a pressure angle of 20 degrees. The face width is 3 inches.

In order to enable a direct drive to be used between the engine crankshaft and rotor of the generator in Diesel-electric drives, and thus eliminate the necessity of using a flexible coupling, a large circular surface is machined by the manufacturer on the end of the generator housing and a similar seat is bored on the end of the engine base. Then the Diesel engine crankshaft and the generator rotor are accurately attached to each other in correct alignment by means of bolts that pass through jig-reamed holes in both the crankshaft and the rotor.

The machining of the seat on an engine base to effect this assembly is shown being performed in Fig. 11 in a large Niles lathe. The fit surface must be concentric with the assembled crankshaft within 0.002 inch, a particularly close tolerance when the comparatively large diameter of the fit is considered, this diameter being approximately 4 feet. To assure this close accuracy, the huge casting is mounted on an arbor 10 inches in diameter, the bearings of the casting being bored to this diameter within 0.0005 inch. Paper is used under the bearing caps to bind the engine base to the arbor. Counterweights are fastened on the engine base, as may be seen by reference to the illustration, to insure vibrationless rotation of the casting, which weighs as much as 5800 pounds on a 600-horsepower engine.

The drilling and reaming of the holes in the generator rotor are performed on a horizontal boring mill as illustrated in Fig. 12. Accurate locating and machining of the holes are insured by means of a collarlike jig which was made 12 inches thick in order to provide an adequate guide for the tool-spindles. This jig seats closely on a machined surface of the generator rotor, and must be positioned accurately with respect to the radial positions of the holes, so as to insure that the holes reamed for the generator will line up with similar holes in the flange of the crankshaft.

The crankshaft holes are customarily machined by the concern from whom the crankshaft is purchased, the construction of the crankshaft and the generator obviating the possibility of reaming them together.



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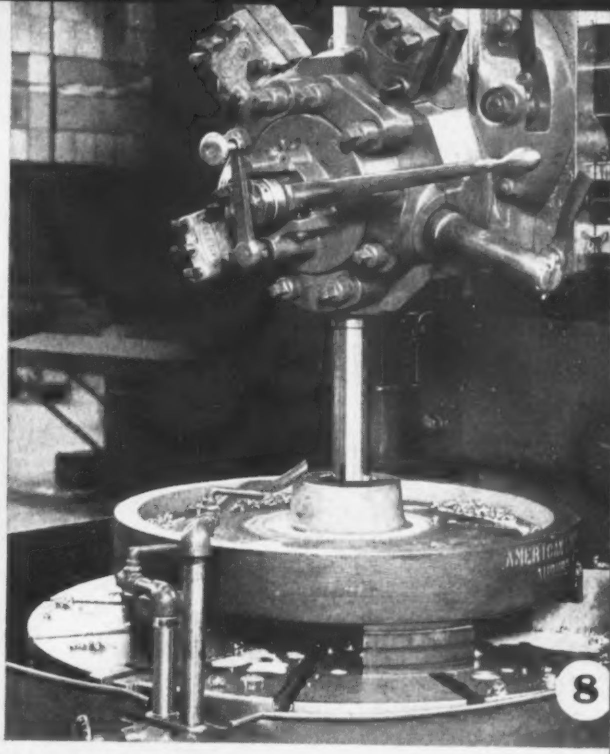

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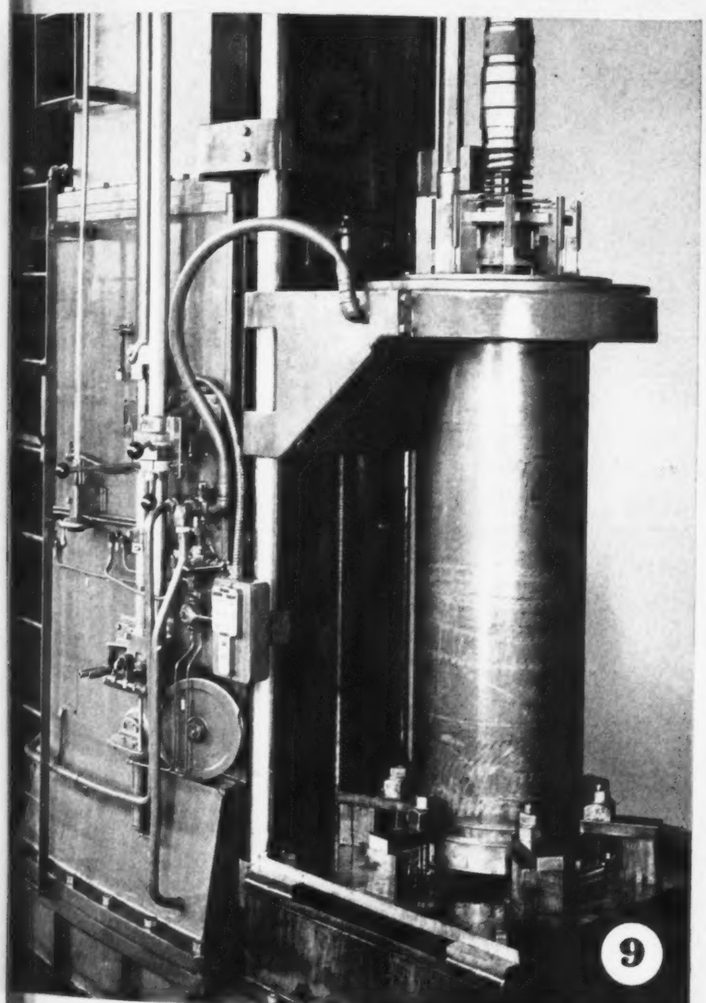

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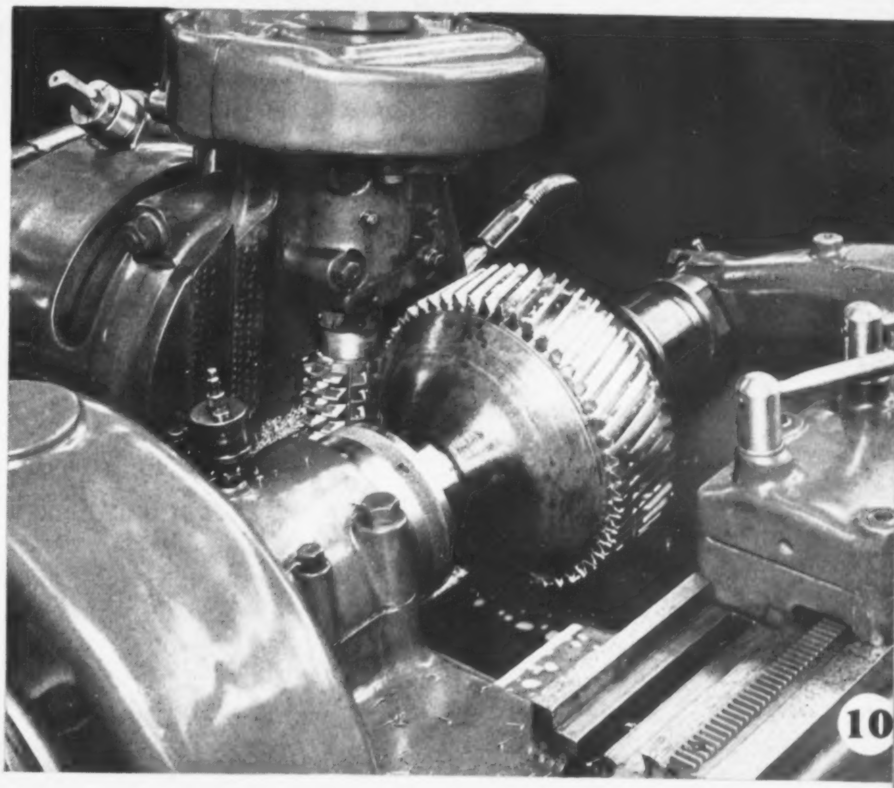

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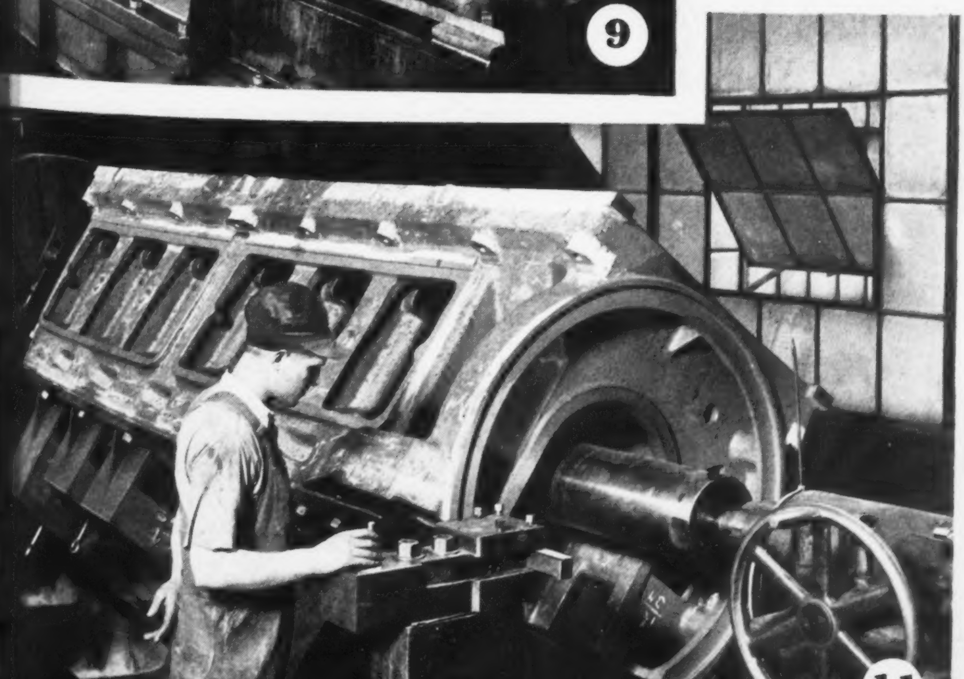

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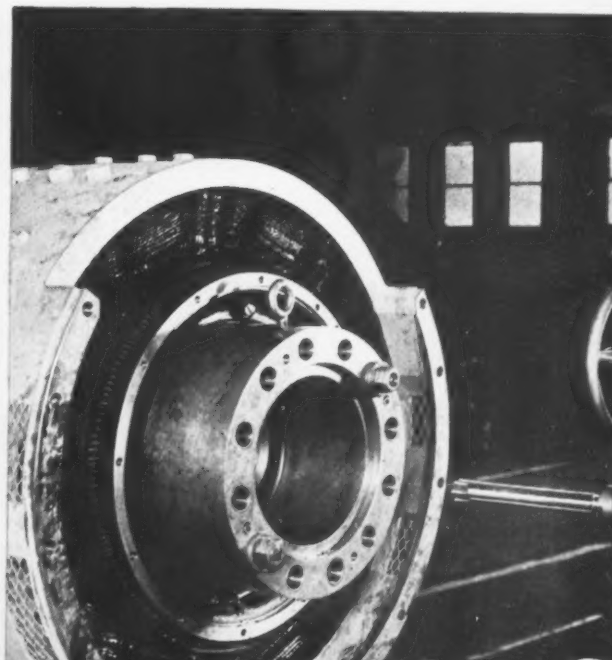

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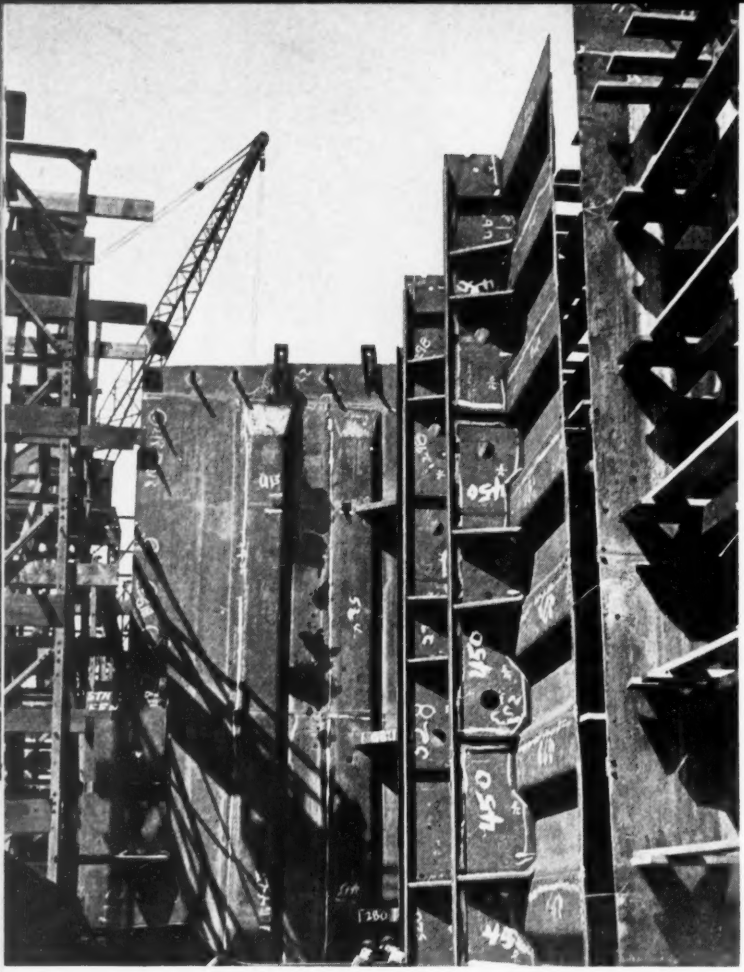

Fig. 1. Bethlehem-Frear Fluted Bulkheads are Used in Oil Tanker Construction with the Flutes Running either Horizontally or Vertically

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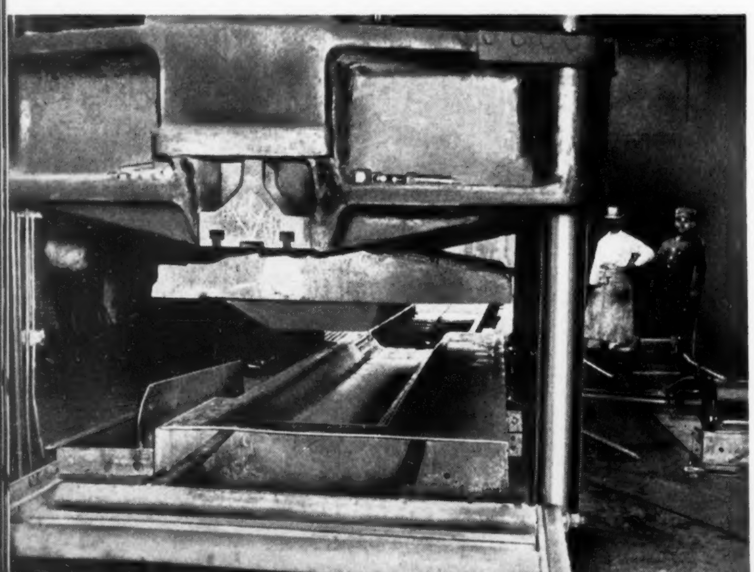
Fig. 2. The Troughlike Shapes are Pressed Hot between the Dies of a Huge Hydraulically Operated Press



Fabricating the

TANKERS capable of carrying five or six million gallons of crude oil from oil fields to refineries are the specialty of the shipbuilding yard operated at Sparrows Point, Md., by the Bethlehem Shipbuilding Corporation, Ltd. Vessels of this type up to 550 feet in length, 75 feet in beam, and 40 feet in depth are being built there at present. One unique feature of this shipyard, which is probably not duplicated anywhere else in the world, is the fact that iron ore is delivered from the mines to the adjacent docks of the Bethlehem Steel Corporation, where it is smelted, poured into ingots, and rolled into plates, etc., which are then shaped, welded and riveted into the hulls of the vessels at the shipyard, just a quarter of a mile away. All of the structural steel that goes into these ships is produced in one of the steel plants of the parent company.

Many of the oil tankers built in this shipyard are constructed with Bethlehem-Frear fluted bulkheads. These bulkheads are built up from plates that have been shaped into a troughlike structure, so as to provide the desired strength and stiffness without the necessity of welding or riveting angle or channel stiffeners to the bulkheads, as is common practice. In addition to the bulkheads, the plating of the shell and deck is supported by frames extending between transverse bulkheads, these frames being given continuity by means of short round bars welded to both bulkheads and frames.

Bulkheads of the type mentioned are used with the flutes both vertical and horizontal, as may be seen in Fig. 1, to divide the ship into a series of tanks for holding the oil. There are usually three tanks in the width of the vessel, while the number of tanks extending longitudinally depends on the length of the ship. Generally, in the transverse bulkheads the troughlike depressions run vertically, and in the longitudinal ones horizontally. The bulkheads are generally welded to the shell and deck of the ship and to each other. Welding is employed for about 75 per cent of the structure, riveting through the cargo tanks being confined to the fore and aft seams of the deck and shell.

The use of Bethlehem-Frear bulkheads reduces the structural weight of a tanker, and therefore provides higher deadweight for the same displacement. Other important advantages include a reduced surface area for cleaning, together with the reduction of joint edges, which are always likely to

Bethlehem-Frear Fluted Bulkheads

cause trouble. The self-draining feature of the fluted trough is also of considerable importance.

Shapes for these bulkheads are formed from steel plates ranging up to 26 feet long, 6 feet wide, and 5/8 inch thick. The forming operation is performed in the 500-ton hydraulic press illustrated in Fig. 2. The plates are first heated for approximately fifteen minutes in an adjacent furnace, which is operated at a temperature of between 1800 and 2000 degrees F. This furnace is approximately 40 feet long and has a hearth 96 inches wide. It is gas-fired. The heated plate is pulled into the press over the huge bottom die seen in Fig. 2, which has a depression for forming the trough and leaving a flange along the two sides and across one end. The cross-section of this plate is in the form of a trough approximately 8 inches deep, with the sides sloping from a width of about 2 feet at the bottom to a width of 3 feet at the top.

In pressing the bulkhead shapes, either end of the machine ram can be operated independently of the other, so that the operator can obtain a rocking action, so as to apply pressure at any point along the shape as required. Flat strips of cold steel are laid on the flanges of a shape after the trough has been formed, so that the flanges can be pressed flat without any pressure being exerted on the surfaces of the trough. Scale is blown from the finished shape by compressed air.

The bulkhead shapes are next sheared to produce straight edges, and are then butt-welded end to end, as shown in Fig. 3, to obtain the desired length and also a flange at each end. Electric arc welding is employed. Sections of the required length and width are next joined by means of lap welds, producing assembled bulkheads, such as shown in Fig. 4, which are fabricated completely before delivery to the adjacent shipways.

Holes for assembly bolts are drilled through the flanges of each lap joint at the beginning of the welding operation, so as to hold the bulkhead shapes in the proper location while the welding of the laps is performed, and these holes are afterward filled with weld metal. The laps are about 2 inches wide. At the end of the welding operation, the edges around the entire bulkhead assembly are beveled, or cut at an angle of 60 degrees, by means of an oxy-acetylene torch. This edge forms a vee with the deck, shell, or other bulkhead of the ship to receive weld metal and insure a strong joint.

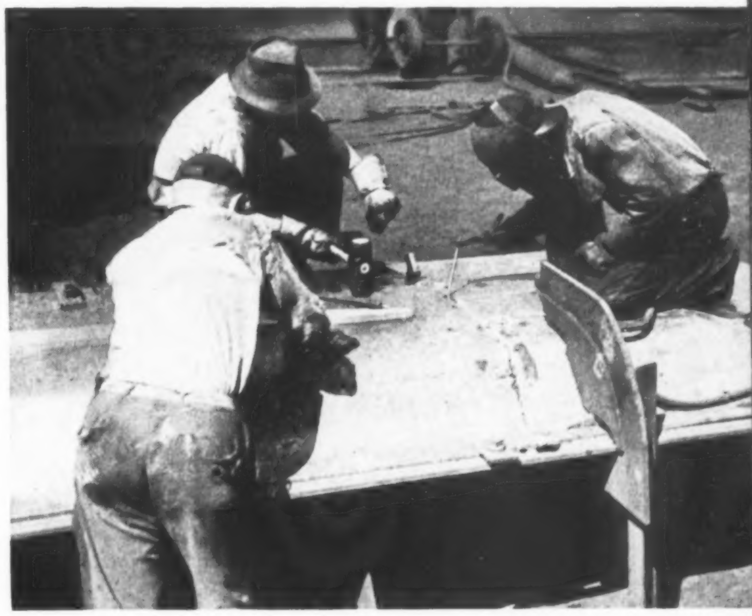


Fig. 3. Bulkhead Sections of the Required Length or Height are Obtained by Welding Together Two or More Fluted Shapes

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Fig. 4. Bulkheads are Completely Fabricated before Delivery to the Shipways. Half of a Bulkhead is Shown Here

Fleet Expansion Activities at

PHILADELPHIA has been known as a leading shipbuilding center ever since Colonial times. Private yards in that city fitted out the first American fleet, this small group of sailing vessels departing from the port soon after the Declaration of Independence was signed. Since that time, naval vessels for war as well as for peace-time service have been constructed in both private shipyards of that city's environs and in the Philadelphia Navy Yard, which was established in 1801. At first near the center of the city, this yard was moved to its present site on League Island in 1876, where it comprises 685 acres of land and about five miles of water front. In addition to shipbuilding, this Navy Yard is devoted to airplane manufacture, the Naval Aircraft Factory having been established here in 1917. This article, however, will deal only with the shipbuilding activities.

The Philadelphia Navy Yard is now considered primarily a building yard rather than a repair yard. At the present time, a 35,000-ton battleship, a 10,000-ton cruiser, and two 1500-ton destroyers are under construction. Two vessels up to 900 feet in length can be built simultaneously on the ways, and there are three dry-docks, one of them over 1000 feet in length.

The largest hammer-head crane in the world was erected on one of its piers for swinging complete turrets, guns, and other equipment aboard ship. This crane has a capacity for swinging loads up to

Fig. 1. Condenser Heads are Shaped by Hammering Them against the Contours of a Structural Jig

Philadelphia Navy Yard

Fig. 2. The Tool Carriage on a Huge Plate Planer is Provided with Toolholders on Two Sides to Enable Cuts to be Taken during Both the Forward and Return Movements

350 long tons at a radius of 115 feet or 50 tons at a radius of 190 feet. Standing at a height of several hundred feet, this structure is a landmark for miles around. It towers over the cruiser seen in the heading illustration.

In common with other industrial yards of the United States Navy, the Philadelphia yard is allotted certain types of work. Here propellers for all naval vessels built in government yards are cast, machined, and dynamically balanced within an ounce-inch. Also, all castings of intermediate size required for the entire Atlantic Seaboard are cast and machined here. Another specialty of the metal-working shops is the fabrication of condensers for all destroyers that are being constructed on the east coast.

Condenser heads are shaped from flat sheets of an alloy by hammering them, as shown in Fig. 1, to the outline of structural jigs, with the sheet clamped against the front face of the jig. One man backs up the metal with a tool of suitable shape, while the other strikes the opposite side of the metal with a mallet. This process is continued until the flat sheet has been hammered to the required contours. The flat plate for the end section receiving the smoothing touches in Fig. 1 is first cut away at two of the corners to permit shaping it to the required curvature. The edges at these corners must conform to the templets that are seen resting on the base of the jig.

Curved corners for these end sections are shaped in similar jigs and then electrically arc welded to the main piece, with the parts located properly in another jig. The completed section is next placed on the stand seen in Fig. 3 for welding flat bars along the sides to serve as reinforcement for the flanges. A water test at a pressure of 30 pounds per square inch is then conducted, with the section fastened to this stand, for the purpose of detecting any leakage.

The machining of a propeller is one of the most important operations in shipbuilding. The propeller for a cruiser is run at speeds up to almost 400 revolutions per minute, and because this part weighs as much as 14,000 pounds, any small amount of unbalance will cause objectionable vibration. Propellers ranging up to 18 feet in diameter are used on naval vessels.

The leading side of propellers is finished on a large Morton draw-cut shaper, a close-up view of

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Fig. 3. Rounded Corners and Flat Bars are Arc-welded to Main Sections of Condenser Head; the Unit is then Tested for Leakage on the Stand Shown

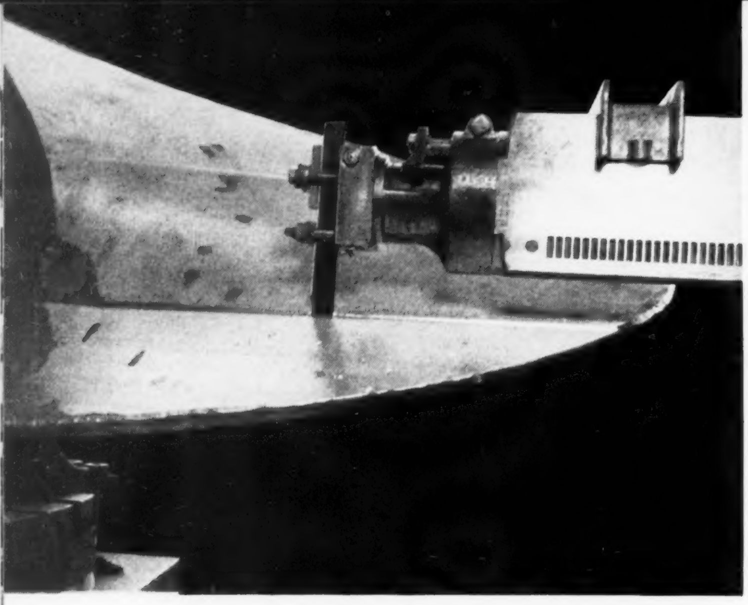

Fig. 4. Propellers up to 18 Feet in Diameter are Machined on the Leading Side by a Morton Draw-cut Shaper

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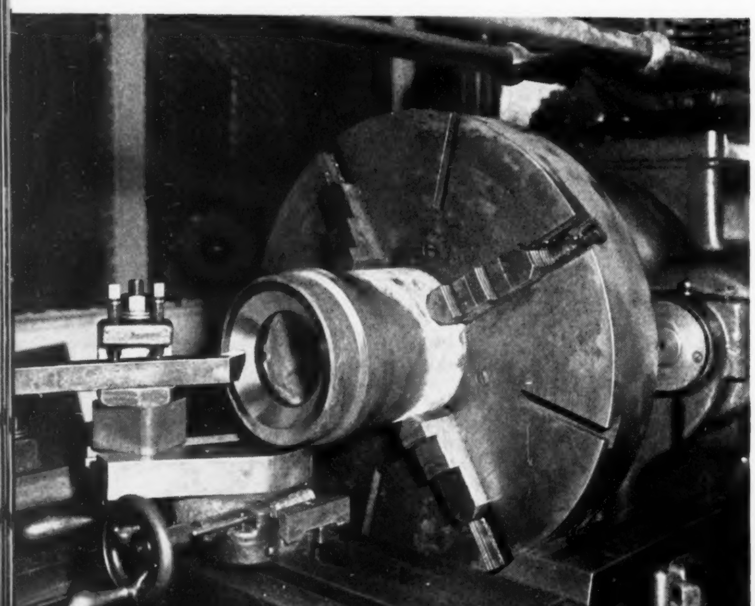
Fig. 5. The Use of Carboloy Tools has Greatly Facilitated the Finishing of Parts for Throttle Valves



a typical operation being shown in Fig. 4. The tool is operated back and forth in a direct line with the center of the propeller. At the end of each cutting stroke, the circular table is indexed about its axis a slight amount and the ram saddle is elevated to correspond with the rise on the propeller blade. This sequence continues automatically until the blade is finished. A special device regulates the length of the ram strokes, so as to effect reversal when the tool reaches the end of the blade, thus avoiding excessive over-travel of the tool and reducing the machining time of the operation.

This machining method is practicable because each element in the leading surface of this type of propeller blade is a straight line extending radially from the center. The back side of the blade is not a true helix, and therefore is finished by using hand tools.

Dynamic balance of propellers is determined on a modified Akimoff machine, and corrections are made until the propeller is balanced within an ounce-inch. The same machine is employed for balancing parts from 10 pounds to 50,000 pounds in weight, including pump rotors, impellers, flywheels, and armatures.

An indispensable machine in shipyards is a plate planer for machining the edges of shell and armor plate. One of these machines in the structural shop at the Philadelphia Navy Yard is illustrated in Fig. 2. It was built by the Baldwin-Southwark Corporation, and is used for plates up to 36 feet long and 10 inches thick. Twenty-five pneumatic jacks operated from cylinders on top of the machine hold the plate securely to the table as the tool carriage passes back and forth along ways at the rear of the machine. Tool-holders are provided on two sides of the carriage so that a cut is taken during the movement of the carriage from left to right and also from right to left. Cuts are taken up to 1 inch wide by 3/16 inch deep on specially heat-treated steel at speeds as high as 26 feet a minute. A typical chip is seen lying near the front end of the plate in the illustration. Tungsten-cobalt tools are used.

An operation of unusual interest in the machine shop is the method of finishing throttle valve seats and valves that are of an unusual degree of hardness. These surfaces were formerly finished by grinding, but are now being machined in less than one-quarter of the time by using No. 883 Carboloy tools in lathe operations. The machining of a valve seat is illustrated in Fig. 5. The valve seats are turned from the rough to the desired radius by

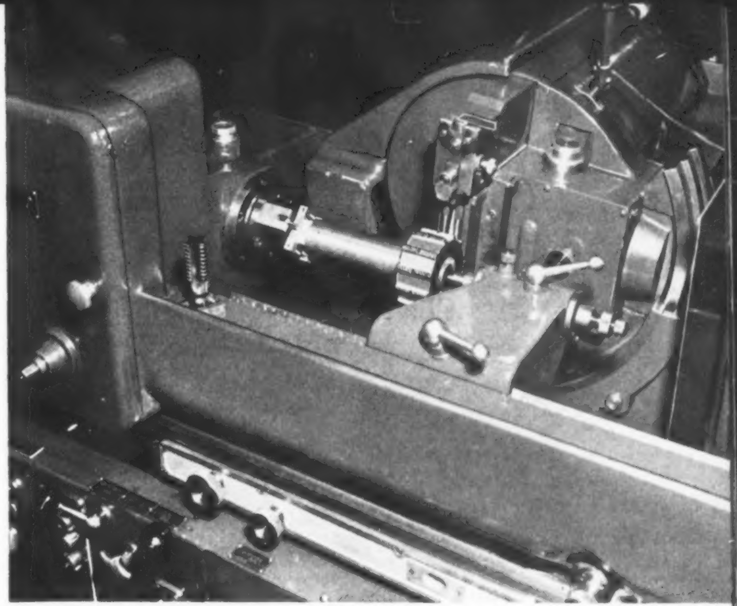


Fig. 6. Threads on a Large Variety of Taps and Gages are Ground from the Solid in an Ex-Cell-O Thread Grinder

mounting the tool on a holder that is swung through the required arc by turning a small crank-handle. Important factors in the success of this operation are the sharpening of the tools on diamond wheels and the gripping of the shank close to the bit, so as to avoid vibration.

The Ex-Cell-O thread-grinding machine shown in Fig. 6 is used for grinding the threads of taps, thread gages, both external and internal, and other parts, directly from the solid stock. The large tap seen between the centers of the machine is a combination roughing and finishing tap for cutting threads of 5 3/8 inches diameter in valve bodies and manifolds. After the threads have been rough-tapped in the part, the tap is reversed on its shank for applying the finishing section. Clearance is provided in the center of the tap between the roughing and finishing portions. The use of this tap has insured uniformity of tapped holes. Another typical tap ground on this machine is seen near the left-hand end of the table.

Pipe from 1 1/4 to 15 inches in diameter is upset on the ends for Van Stone joints by means of the equipment shown in Fig. 7. For this operation, the front end of the pipe is gripped in a split die, one-half of which can be swung upward, as shown, for loading and unloading. The pipe, after being heated in an adjacent furnace to 1650 degrees F., is placed in this die with the back end supported by a carriage which is locked to the bars seen extending toward the left. Then the split die is closed and locked in place by the application of pneumatic pressure.

The pipe is formed in the die by a tool shaped to the internal contour to be produced, which revolves around an eccentric path as it advances into the work, thus forcing the pipe wall against the die cavity. The illustration shows 6-inch molybdenum steel pipe being upset. The surfaces upset are later finish-turned in a lathe operation.

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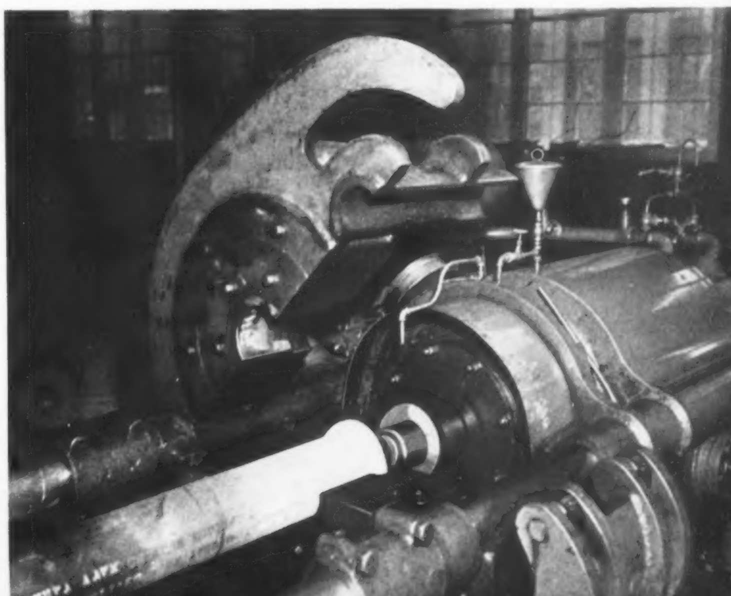
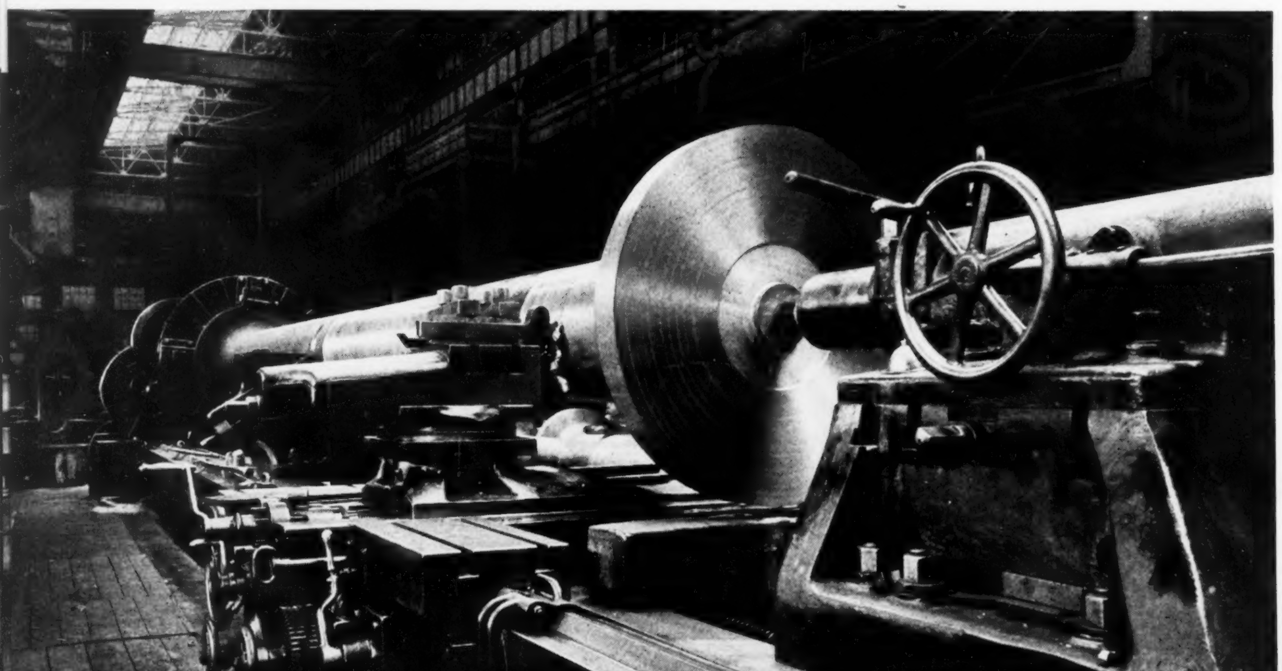
Fig. 7. Equipment for Upsetting the Ends of Pipe from 1 1/4 to 15 Inches Diameter for Making Van Stone Joints



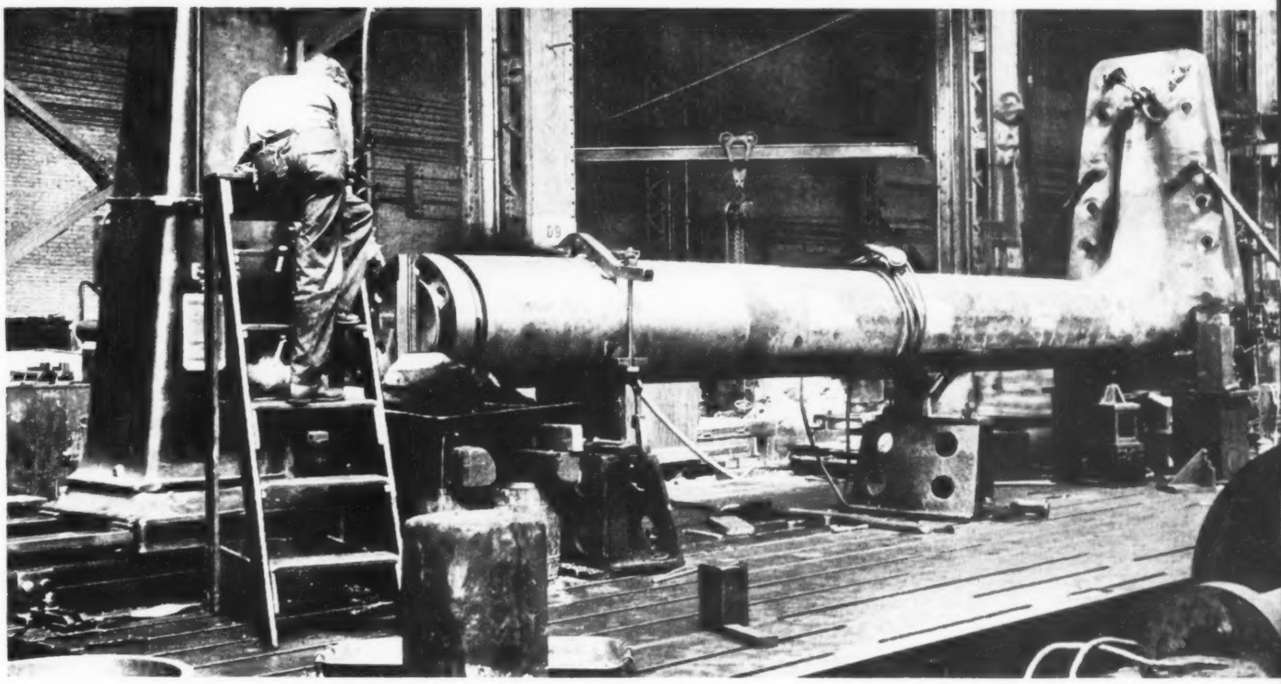
Camera Impressions in One of

(Above) The Covered Ways and Wet Slip of the New York Shipbuilding Corporation, Camden, N. J., Enable the Building of Ships to Proceed without Interruptions due to Ice, Snow, or Rain, and also Protect Workmen from the Broiling Mid-summer Sun. Roofed Ways are a Unique Feature in a Yard Used Primarily for the Building of Large Ships

(Below) The Heavy Machine Shop is Housed in a Building Over 800 Feet Long. This Illustration Shows a Niles Lathe in the Heavy Machine Shop Turning a 28-foot Section of the Lineshaft for the S.S. Manhattan. The Bearings were About 18 Inches in Diameter and had to be True to Size within 0.001 Inch. The Entire Shaft had to Run True within 0.003 Inch

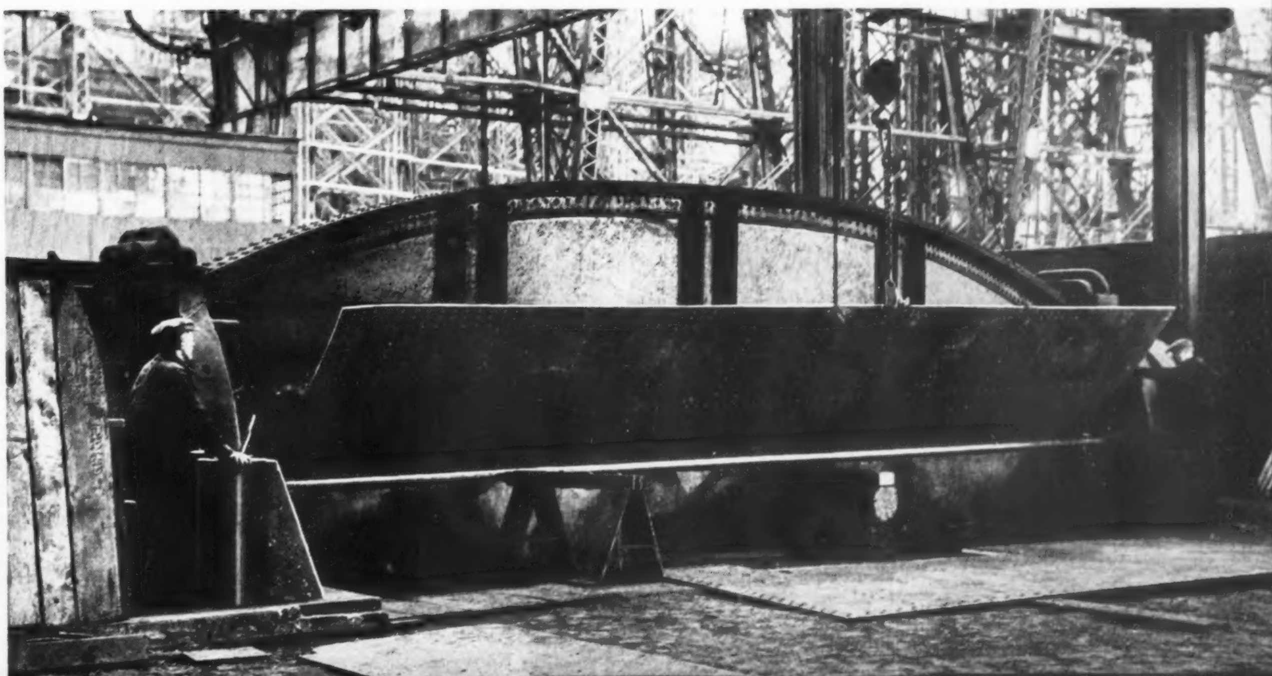


the World's Largest Shipyards



(Above) Machining the Rudder Stock Forging for a Large Vessel by Applying a Landis Portable Boring, Drilling, and Milling Machine which was Carried to the Floor Plate on which the Huge Forging was Set Up. The Operation Consists of Milling Keyways along Both Sides of the Shank for a Distance of Several Feet for Attaching the Steering Gear Cross-head

(Below) The Bending Roll Illustrated is One of Several in the Structural Shop. It Has a Capacity for Bending Plates Cold up to 31 Feet in Length by 7/8 Inch in Thickness. The Machine Has a Rating of 50 Horsepower. The Plates are Carried Directly from the Bending Roll to the Shipways Seen in the Background by Means of Overhead Transfer Cranes



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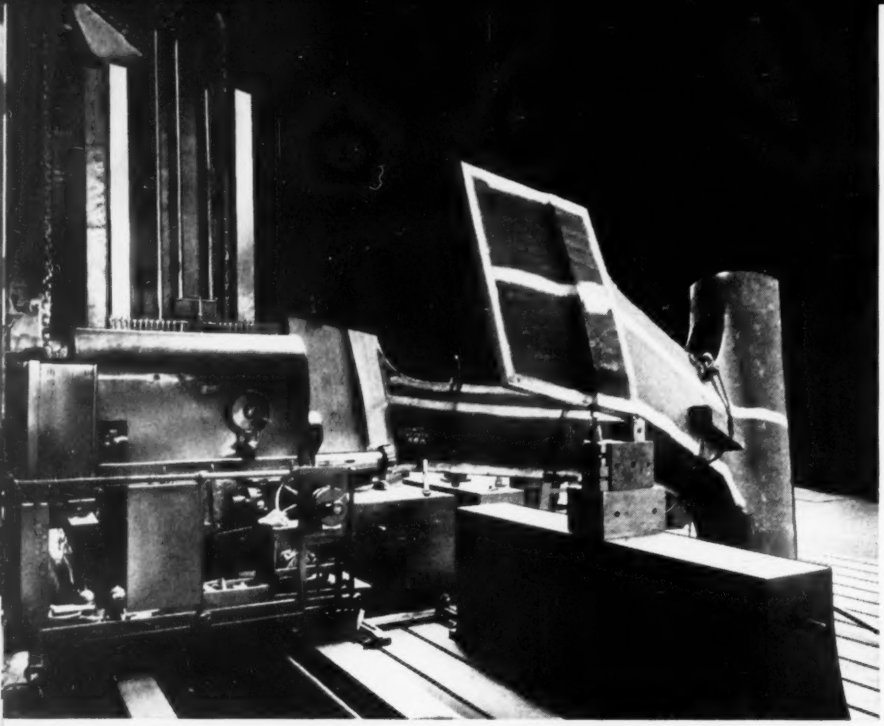
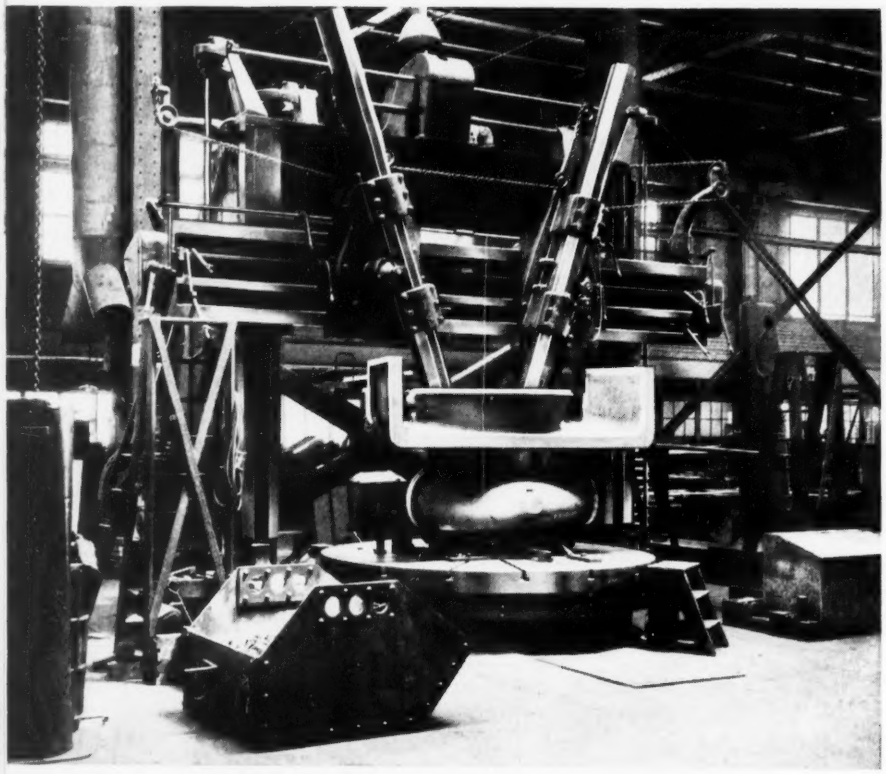
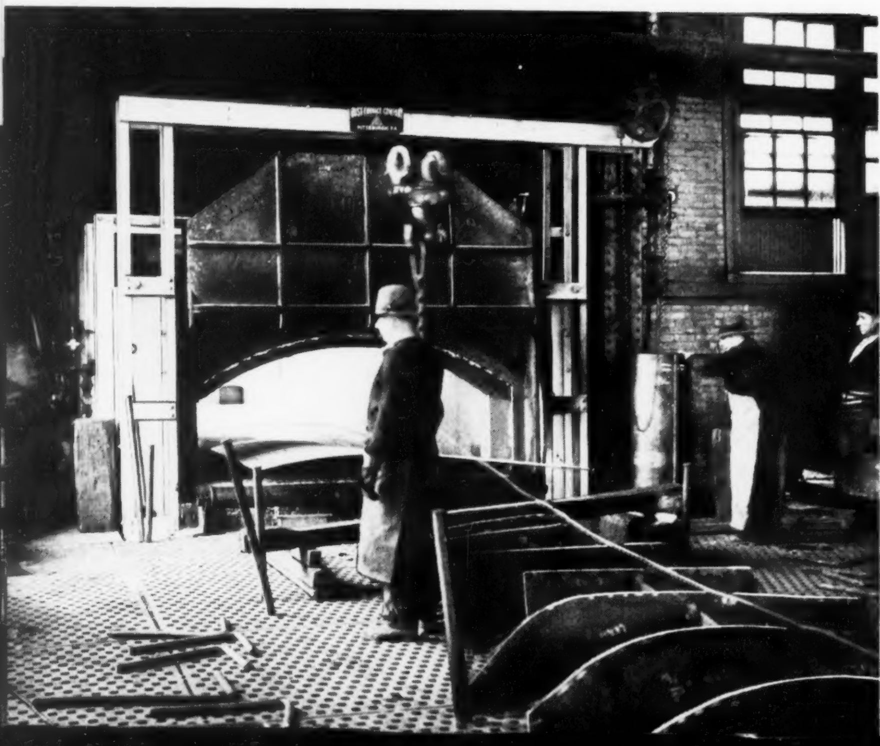


Huge Propeller Shaft Strut being Milled on One of the Palms by Means of a Sellers Horizontal Boring, Drilling, and Milling Machine. The Strut is a Steel Casting, Weighing About 9 Tons, the Bearing End of the Strut being 8 Feet Long. Two Struts of This Size and Two Smaller Ones are Required on a Vessel Driven by Two Propellers

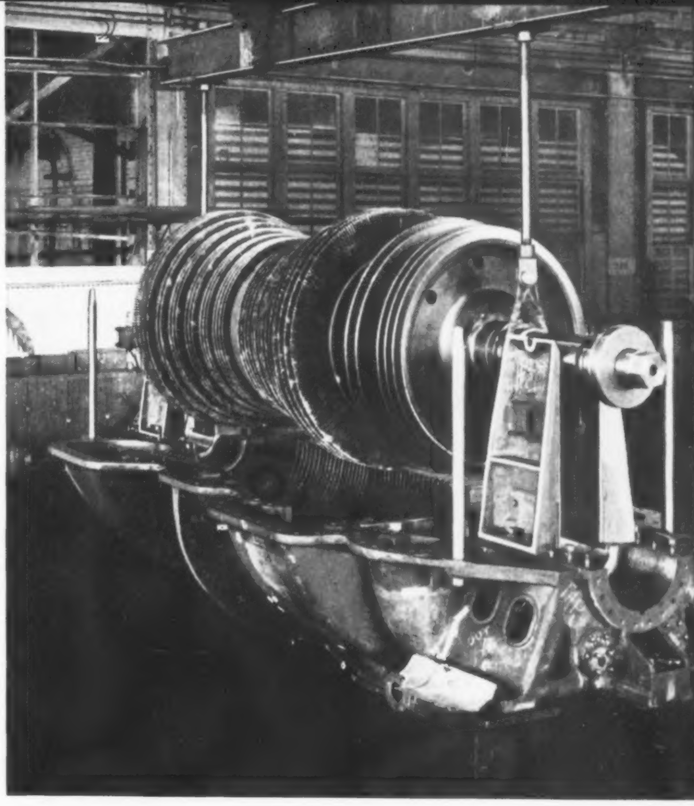


Rough Taper-boring the Inside of a Cylinder for a Low-pressure Turbine on a Niles Vertical Boring Mill. Cutters are Used on Both Tool Rams, the Rams being Fed Downward at the Required Angle while the Table Revolves. The Tapered Surface, which is About 4 1/2 Feet in Diameter at the Large End and 3 Feet Long, is Finish-bored on a Horizontal Machine within Close Limits

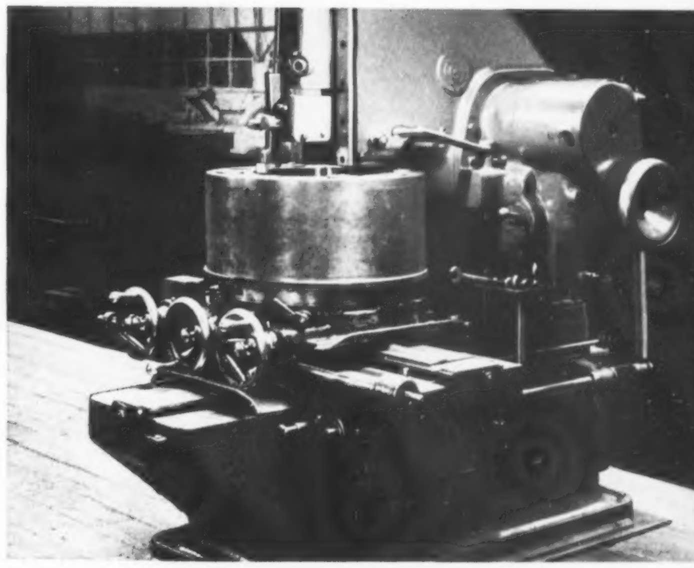


Plates that Must be Shaped to Changing Contours, Such as Those Required at the Bow and Stern of Vessels, are Formed on Templets Set Up on Bending Slabs, as Shown. The Heated Plates are Laid on These Templets when Taken from the Furnace, and Clamped Down by Means of Dogs Fastened in the Slab Holes. The Plates Retain the Desired Contours after Cooling

ONE OF THE LARGEST SHIPYARDS



Assembling the Rotor of a Turbine in the Cylinder is an Operation that Requires Great Care in Order to Avoid Damaging the Turbine Blades or the Journal Bearings. By the Use of Guide Columns Temporarily Attached to Both Ends of the Cylinder, as Shown, the Rotor can be Lowered into Place with Its Blades and the Journals in Proper Alignment with the Cylinder Elements



Machining Keyways in the Inboard Shaft Coupling that Connects the Stern Tube with the Propeller Shaft, the Operation being Performed on a Pratt & Whitney Vertical Shaper in Several Cuts. The Sizing Tool Seen in the Ram is Used to Take a Final Light Cut on the Two Sides and Bottom of the Keyways after They have been Machined to Approximate Size with Other Tools. Four Keyways are Cut around the Coupling, which is Made of Nickel Steel

Constant-pitch Propellers are Finished on the Leading Side by a Planer, and Variable-pitch Propellers by Means of Portable Electric Chipping and Sanding Tools. This Illustration Shows One of the Huge Propellers Made for Driving the S.S. Manhattan, on a Static Balancing Stand. Two Propellers Approximately 19 Feet in Outside Diameter and Weighing About 20 Tons Each are Required to Drive That Liner

Building Battleships at

FIFTY-SIX "men of war" have been launched at the New York Navy Yard since it was established in 1801. In the early days, frigates, sloops of war, brigs, and schooners—all vessels of wood and sails—were the products of this Yard. Then steamers were built, at first also of wooden construction, but of steel after the famous victory of the *Monitor*, which presaged the passing of wooden war vessels.

In recent years, first-class battleships and various types of cruisers and smaller craft have been constructed. Present vessels of importance under construction are the U. S. S. *Helena*, a 10,000-ton cruiser which was launched in August (shown sliding down the ways in the heading illustration), and the U. S. S. *North Carolina*, a 35,000-ton battleship which is on one of the ways.

The manufacturing equipment of United States Navy Yards compares very favorably with that of plants in private industry. This will be apparent from the accompanying photographs, which were taken at the New York Navy Yard. Congress has realized that modern war vessels can be built only with efficient machine tools, and accordingly has made annual appropriations for the elimination of obsolete equipment. The appropriation for the fiscal year is considerably greater than in the past, and indicates additional "manufacturing preparedness" for the naval expansion program.

In Fig. 1 is shown a Giddings & Lewis boring, drilling, and milling machine equipped with a work-holding floor plate 18 feet long by 8 feet wide. A universal tilting and rotary table and an end support for the boring-bar are mounted on the floor plate. A special attachment provides for precision thread-cutting. The headstock has a vertical feed of 77 inches on the column, and the column has a horizontal travel of 72 inches. This machine has been erected on a solid concrete foundation, which, in turn, is supported on steel and concrete piles that extend 30 feet into the ground. In the opera-

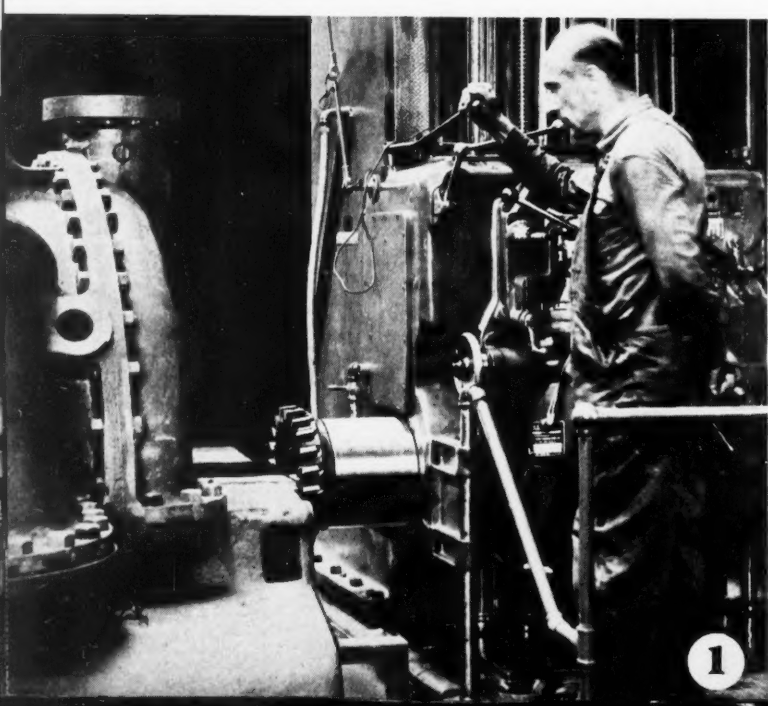


Fig. 1. Huge Boring, Drilling, and Milling Machine Face-milling Bosses on End of a Large Turbine Casing

Fig. 2. Vertical Turret Lathe Facing Flanges of a Bulkhead Pipe Elbow and Boring and Threading This Part to Receive Two Seats

New York Navy Yard

tion illustrated, face-milling cuts are being taken on the bosses of a large turbine casing.

The Bullard vertical turret lathe shown in Fig. 2 is adapted for machining a large variety of ship parts, either in small or large lots. The job illustrated consists of facing the flanges of a large bulkhead pipe elbow and of boring and threading the elbow to receive two inserted valve seats.

The American lathe shown in Fig. 3 is machining a circular dovetailed groove from the solid in a casting of high nickel content. This part is approximately 2 feet in diameter. It is also drilled, bored, and reamed in the center by the same machine.

Accurate boring of jigs and fixtures and also of precise work-pieces required in quantities not large enough to warrant the making of jigs is performed on the Pratt & Whitney jig-boring machine illustrated in Fig. 4. The operation shown consists of boring holes around a drill jig for the propeller shaft couplings. The center-to-center distances between these holes on a 30-inch circle must be true within 0.0005 inch, and the hole diameters are held to the same limits. The boring head is of the universal type manufactured by the Precision Tool Co.

Another modern machine in the tool-room is the Pratt & Whitney universal die-sinker seen in Fig. 5. This machine is designed to move the cutter automatically in a vertical direction, as required for milling contours in forging dies and similar work. The construction eliminates the necessity of using cherrying cutters and greatly reduces the amount of hand finishing required.

A Morton draw-cut shaper is illustrated in Fig. 6 performing a series of milling, drilling, and reaming operations on a turbine casing. The various tools used on this job can be seen lying on the table in front of the work. Slotting operations are also performed on this machine by using a special attachment.

Work of many different kinds is handled by the

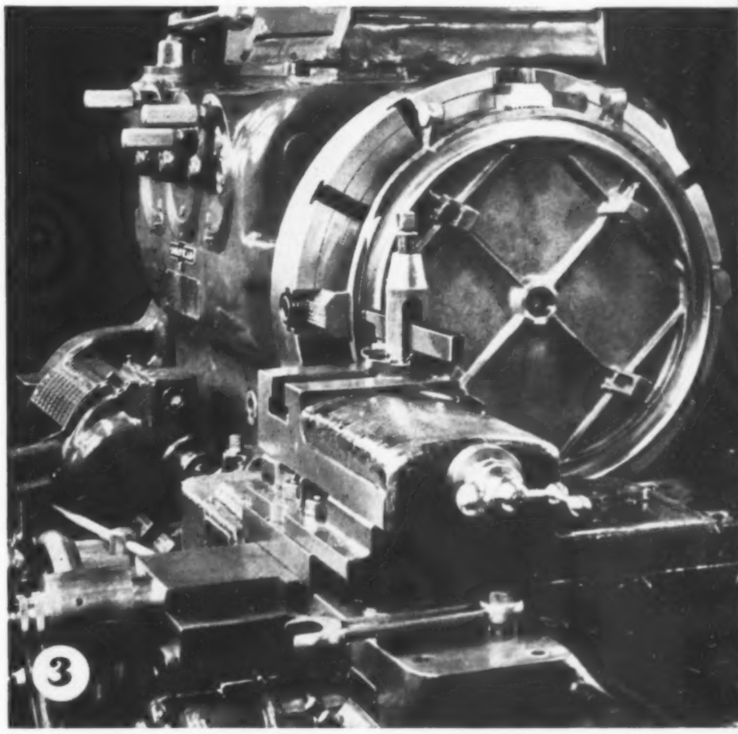


Fig. 3. Machining a Circular Dovetailed Groove from the Solid in a Casting of High Nickel Content

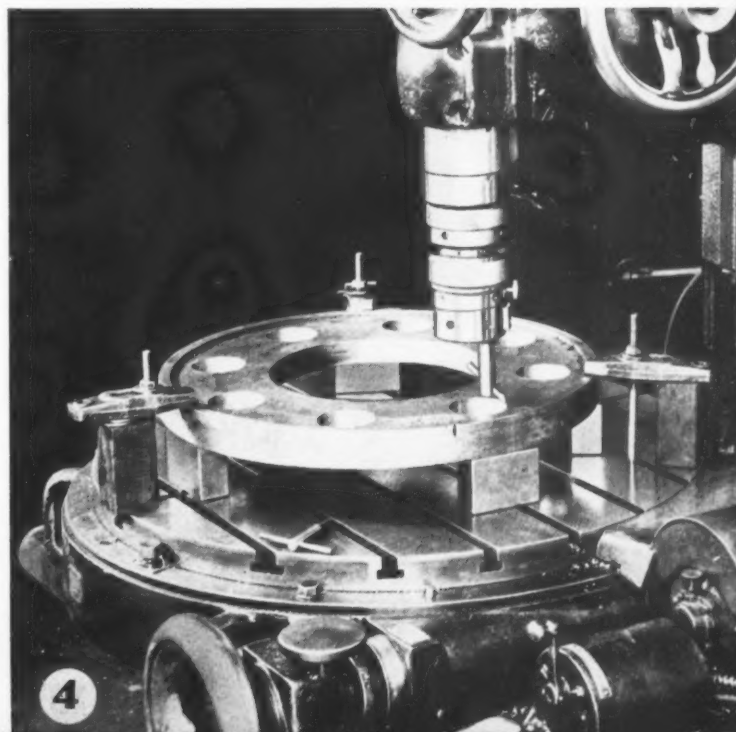


Fig. 4. Jig-boring Machine Finishing the Holes in a Drill Jig for Propeller Shaft Couplings to Extremely Close Limits

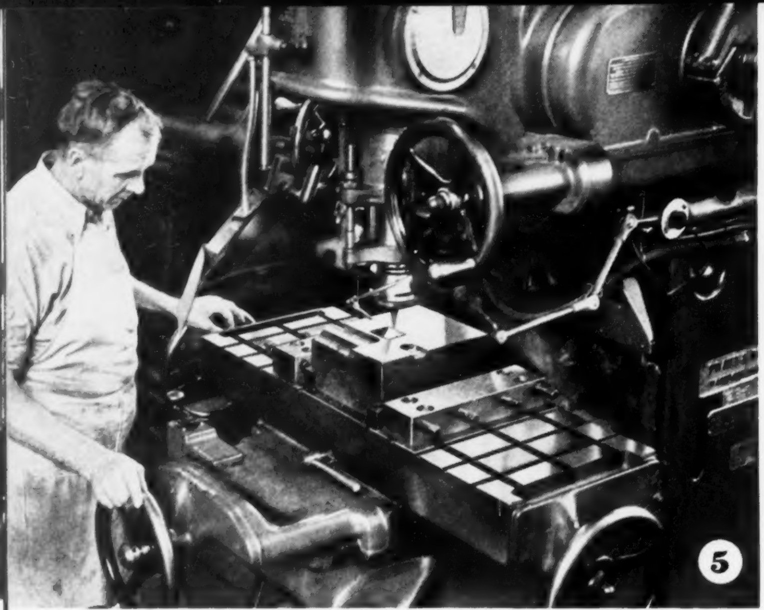


Fig. 5. Universal Die-sinker Used for Cutting Irregular Contours in Forging Dies and Similar Work

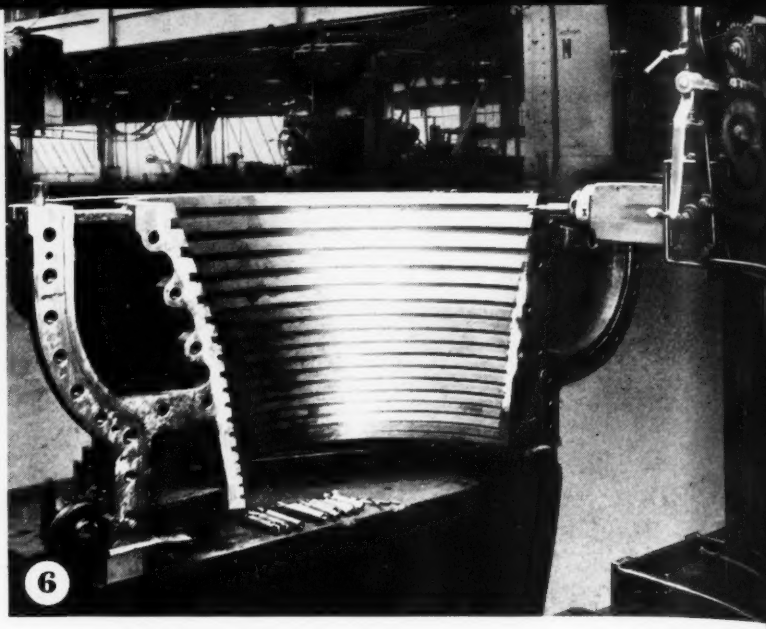


Fig. 6. Draw-cut Shaper Used for End-milling, Drilling, and Reaming Operations on a Turbine Casing

Blanchard surface grinder shown in Fig. 7. Main bearing caps for Diesel engines are seen on the magnetic chuck. These caps are ground on both sides and on the ends by the surface grinder. The length is highly important, and must be held within plus or minus 0.0005 inch on bearings 7 1/2 inches long. The height gage seen at the left, fastened to the machine frame, facilitates grinding within this close degree of accuracy.

A Micro internal grinding machine is shown in Fig. 8 finishing the bore of a liner for Diesel engines. These liners range in inside diameter up to 20 7/8 inches, and in length up to 42 inches. The internal diameter must be within 0.0005 inch of the specified size and the bore must be straight within the same tolerance. The liners are semi-steel castings.

The Sellers horizontal boring mill shown in Fig. 9 is also used for a large variety of work. It is shown equipped with a universal tool-head, made by the Precision Tool Co., which enables the tools to be fed radially outward without shifting the position of the boring head itself in machining such parts as bulkhead pipe elbows.

Fig. 7. Grinding the Main Bearing Caps for Diesel Engine Crankshafts on Both Sides and on the Ends

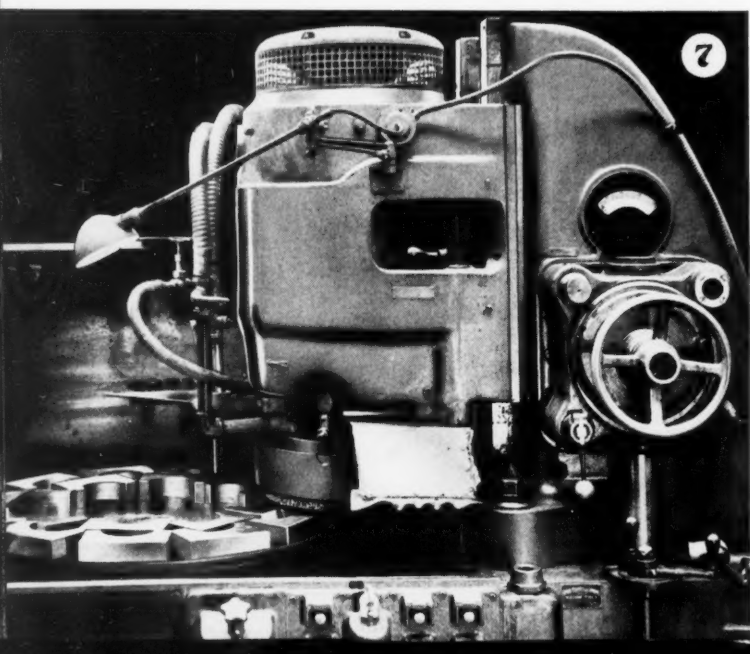
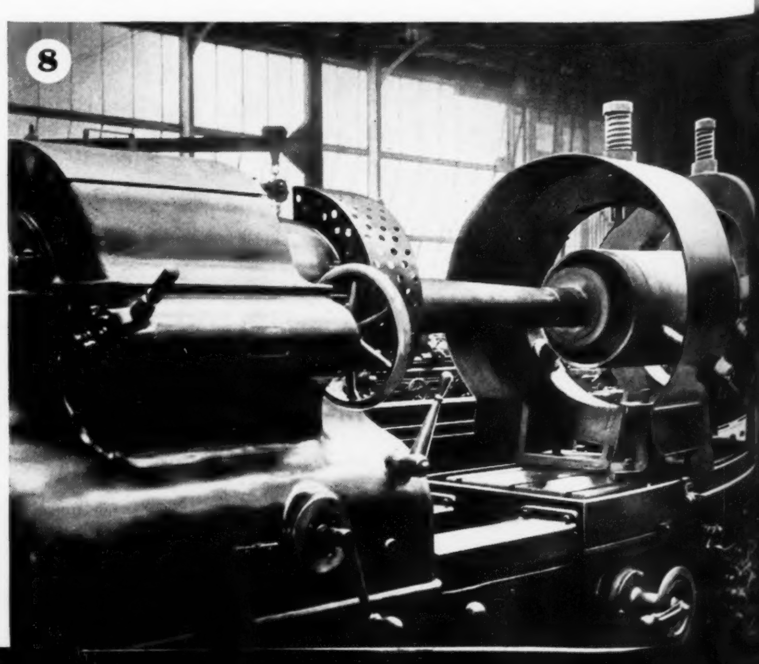
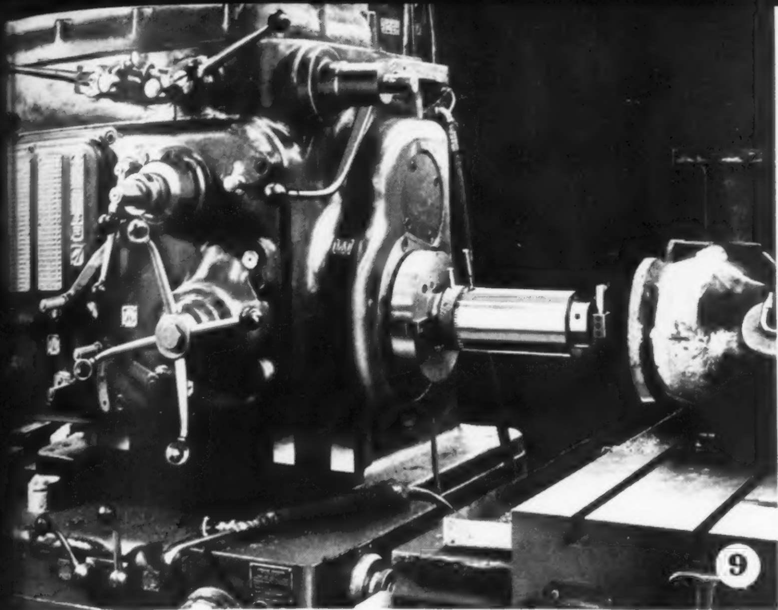


Fig. 8. Grinding the Bore of a Cylinder Liner for Diesel Engines Accurate within 0.0005 Inch





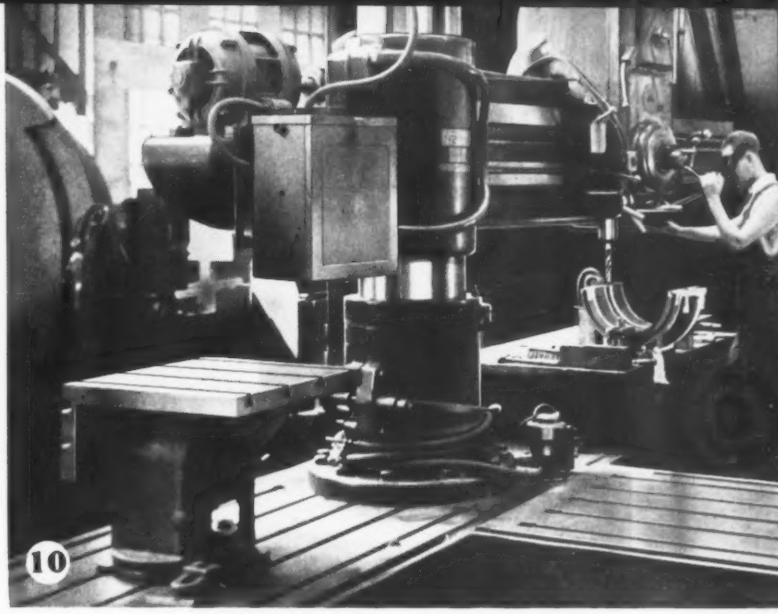


Fig. 9. Boring Mill with Precision Universal Toolhead which Enables the Tool to be Fed Radially

Fig. 10. Radial Drilling Machine with Base Extending in Three Directions to Expedite Setting up Work

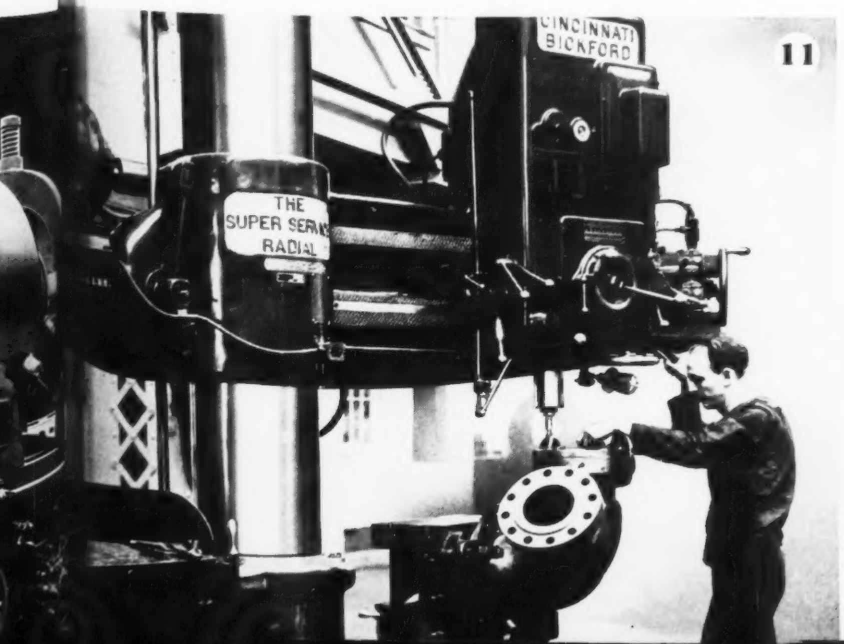
Radial drilling machines of various makes have been installed within the last few years. In Fig. 10 is seen a Fosdick machine of this type equipped with a 9-foot arm. This machine has bases extending from two sides of the column and in front. With this arrangement, work can be set up on two of the bases while an operation is being performed on the third. Also, large castings can be firmly supported by spanning them diagonally across two base extensions. In the operation shown, the cap of a steadyrest for a propeller shaft is being drilled.

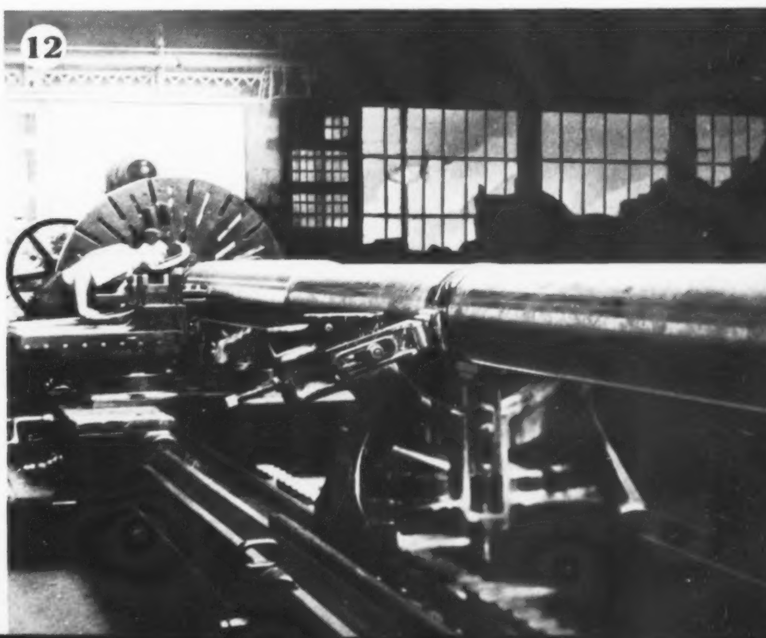
A Cincinnati-Bickford radial drilling machine is shown in Fig. 11 drilling twelve holes of 1 1/16 inches diameter around each flange of a triple-outlet bulkhead pipe elbow. A jig is clamped to each flange to insure accurate center-to-center distances.

Long propeller shafts and their bearings are turned on a lathe which has a length of 100 feet between centers, as shown in Fig. 12. The tolerance on diameters of 20 inches is plus or minus 0.0005 inch. Headstocks and tailstocks are provided at both ends of the bed, so that two pieces of work can be handled at the same time when the full capacity of the lathe is not required for one job.

Fig. 11. Drilling Flange Holes in a Bulkhead Pipe Elbow with a Jig Plate Clamped to the Elbow Flange

Fig. 12. Turning a Bearing on a Propeller Shaft in a Lathe with a Length of 100 Feet between Centers





Turbine Reduction Gears Cut in Air-Conditioned Rooms

REDUCTION gears for the steam turbine drives of ships must be machined to extreme degrees of accuracy in order to obtain successful operation at the customary high rates of speed. The gears mounted on propeller shafts range up to 12 feet in diameter and run at speeds as high as 400 revolutions per minute. The pinion in the reduction train may run as fast as 6000 revolutions per minute.

Double-helical gears of this large diameter are produced at the South Philadelphia Works of the Westinghouse Electric & Mfg. Co. with the pitch diameter accurate within plus or minus 0.002 inch. Of even greater importance to gear performance than accuracy of pitch diameter is correctness of the helix angle of the gear teeth, uniform tooth spacing, and correct tooth contour. In the Westinghouse plant, satisfactory turbine gears are the result of maintaining the tooth-cutting machines and their hobs in as nearly perfect condition as possible. The machines are thoroughly checked at frequent intervals to make certain that the bearings, worm-gearing, and lead-screw are in first-class condition, so that they do not introduce errors into the tooth-cutting operation. Similarly, the elements of all hobs used in cutting the gear teeth are inspected frequently.

Even with first-class machines and tools, however, certain precautions must be observed during the manufacturing stages to produce satisfactory gears. One important precaution is to maintain uniformity of the operating temperature, because changes in the room temperature will cause inaccuracies in the helix angle of the different teeth, with the result that all the teeth in the finished gear will not come in contact with the full width of the teeth on the mating pinion. Changes in the temperature are also likely to result in an "out-of-round" pitch circle.

The cutting of the teeth on large turbine gears is a matter of weeks, and is performed day and night without stopping the machine, except to change the hob for the finishing cut after the roughing of the teeth has been completed. In cutting a gear of the size seen being lifted from the machine in Fig. 1, for example, approximately eighteen days are required for roughing the teeth and seven days more for finishing them.

Uniform temperature throughout the cutting of reduction gears in the Westinghouse shop has been made possible by the erection of heat-insulating walls and ceilings over the individual gear-cutting machines to form rooms in which an even temperature can be maintained during the entire period of gear-cutting. Cooled air is supplied to these rooms in the summer by refrigerating apparatus, and heated air in the winter. The practice is to maintain the temperature in the rooms at 70 degrees F., although the exact degree is not important so long as the temperature existing at the beginning of the operation is maintained to the end. Recording thermometers produce records of any temperature changes throughout the operation, and these records are filed for future reference.

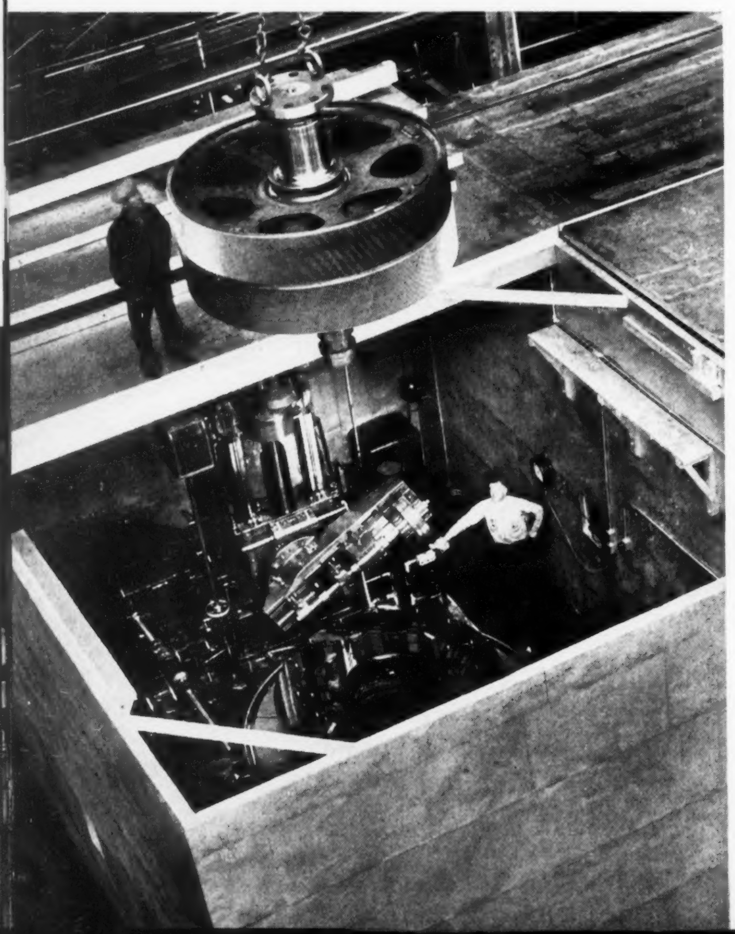


Fig. 1. Reduction Gears for Use in Westinghouse Turbine Drives are Hobbed in Rooms that are Maintained at a Uniform Temperature throughout the Entire Hobbing Period, which Sometimes Lasts as Long as Twenty-five Days

The interior of one of these uniform temperature rooms is shown in Fig. 4, the machine in this particular room having a capacity for cutting gears up to 200 inches in diameter. Fig. 1 shows the method of transporting the work to and from the gear-cutting machines—by means of an overhead crane after a section of the ceiling has been removed. At the end of the tooth-hobbing operation, all gears are balanced dynamically.

When light weight is required, gears are made of welded steel construction, as seen in Fig. 1, although many gears are made with cast-iron centers and steel rims shrunk and keyed to the centers. The large gears are turned to the required diameter within plus or minus 0.002 inch prior to the hobbing operation, the gears being mounted on their journals and supported by steadyrests and on centers, as illustrated in Fig. 3. With this accuracy in the turning operation, the teeth can be readily cut to the required pitch diameter in the hobbing operation by merely feeding the hob into the gear periphery an amount corresponding to the addendum of the teeth. The lathe shown in Fig. 3 has a swing of 160 inches.

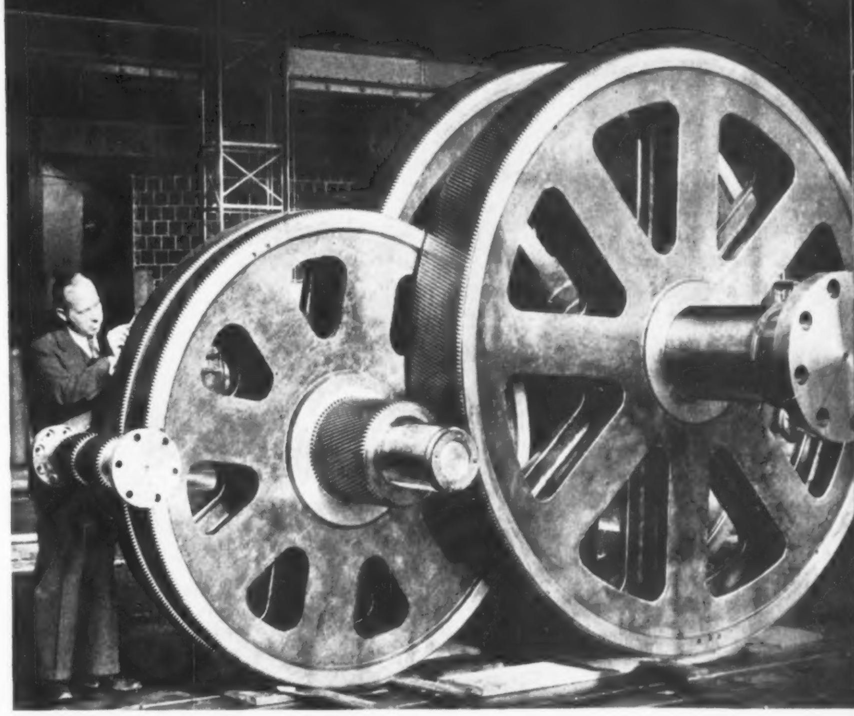


Fig. 2. (Above) Gears up to 12 Feet in Diameter which Run at Speeds as High as 400 Revolutions per Minute are Used in Marine Turbine Drives. This Illustration Shows Double Reduction Gearing for a Westinghouse Turbine

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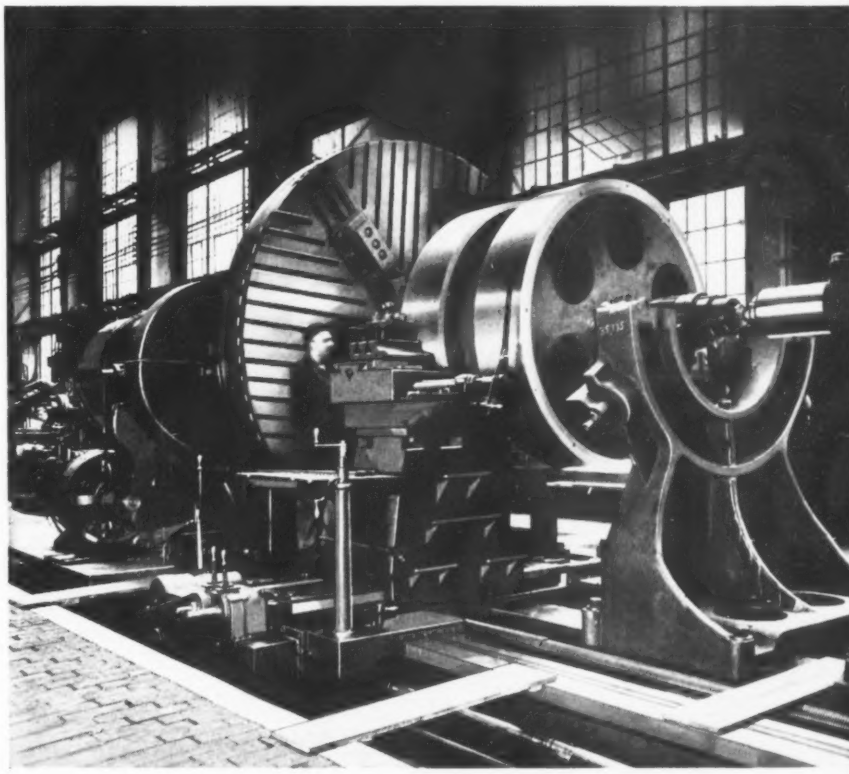

Fig. 3. (Center) Turning of the Large Gear Blanks within Plus or Minus 0.002 Inch of the Specified Outside Diameter Facilitates Accurate Gear Hobbing. The Lathe Has a Swing of 160 Inches

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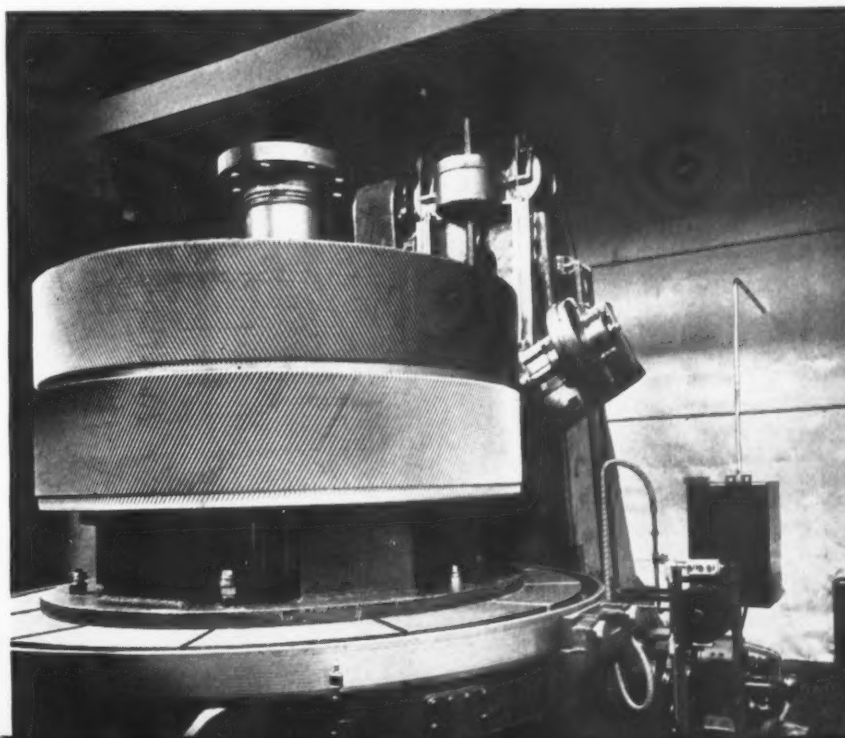


Fig. 4. (Bottom) Interior View of an Air-conditioned Hobbing Room with a Gear Approximately 6 Feet in Diameter being Finished. The Temperature is Generally Maintained at 70 Degrees F.

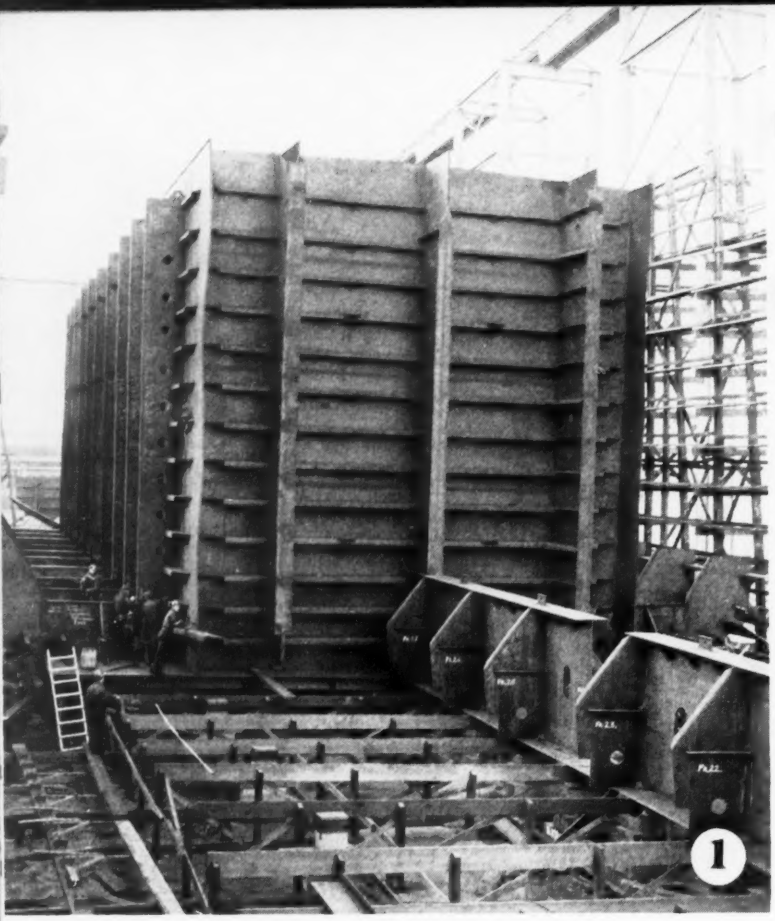
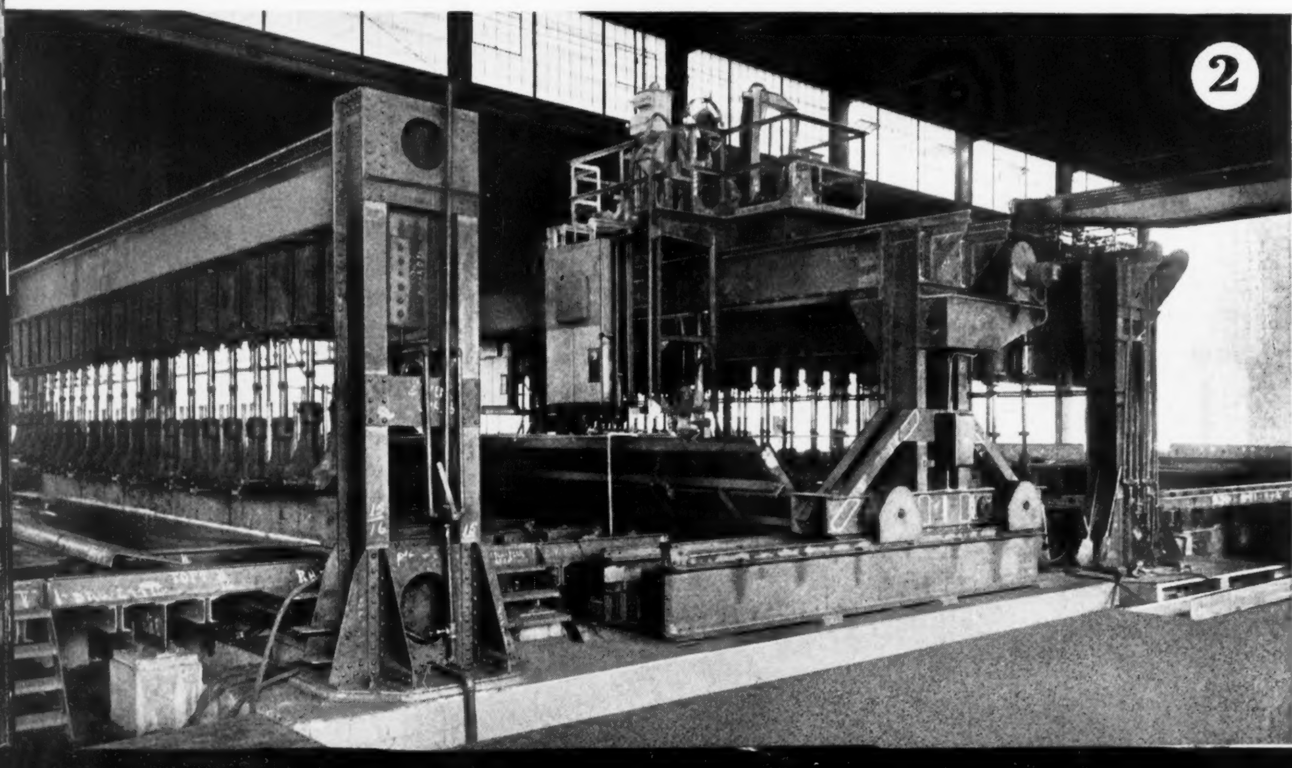


Fig. 1. Preliminary Stage in the Erection of an Oil Tanker on the Sun Shipways, Showing the Type of Bulkheads Fabricated on the Huge Welding Machine that is Illustrated in Fig. 2

Fig. 2. Automatic Welding Machine Used for the Complete Fabrication of Bulkhead and Shell Sections in the Shop before They are Delivered to the Shipways



Outstanding

LAST February the first large ship built anywhere in the world with the entire oil cargo section of welded construction was completed by the Sun Shipbuilding and Dry Dock Co., Chester, Pa. This vessel was the steamship *J. W. Van Dyke*, an oil tanker of 18,500 tons dead-weight, which was built for the Atlantic Refining Co. This tanker has an over-all length of 521 feet, a beam of 70 feet, a depth of 40 feet, and a capacity for carrying approximately 6,500,000 gallons of oil.

The completely welded tank space extends a distance of 353 feet forward from the engine-room bulkhead. With the welded construction, there is a saving in weight that amounts to 11 per cent of the total tonnage of steel required, and there are a number of other important advantages.

This vessel is believed to be the first large tanker to be constructed with a turbine electric drive. The propulsion unit has a rating of 5000 horsepower. A similar ship has since been completed and is now in service, while a third ship of this type is under construction for the same company.

The building of these vessels, approximately 85 per cent by electric welding, has attracted much attention from naval architects and marine engineers. Most of the welding, with the exception of the actual assembling of the various bulkheads to each other and to the shell sections on the shipways, is performed in the structural shop by the huge automatic machine shown in Fig. 2.

At the first station of this machine, longitudinal stiffeners, such as seen welded to the bulkheads in Fig. 1, are pressed into close contact with a bulkhead plate by a large number of overhead pneu-

Operations at the Sun Shipyard

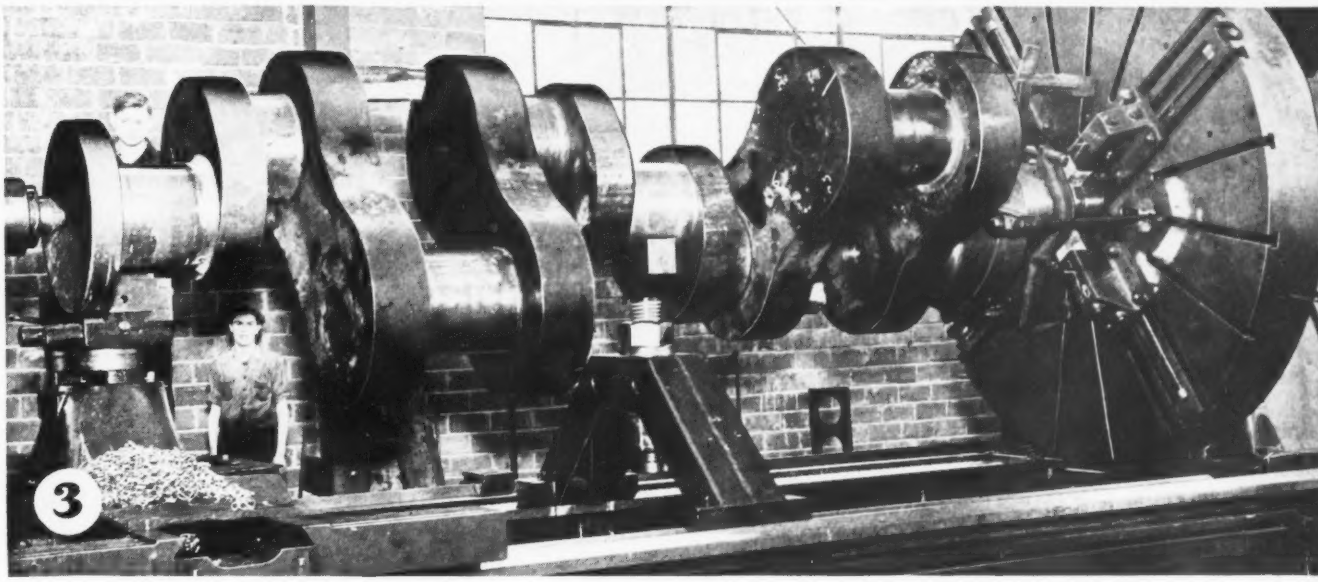


Fig. 3. Huge Crankshafts for Sun-Doxford Diesel Engines, which are Built up from Individual Journal, Crankpin, and Crank-arm Forgings, are Finish-turned on the Journals in This Large Lathe

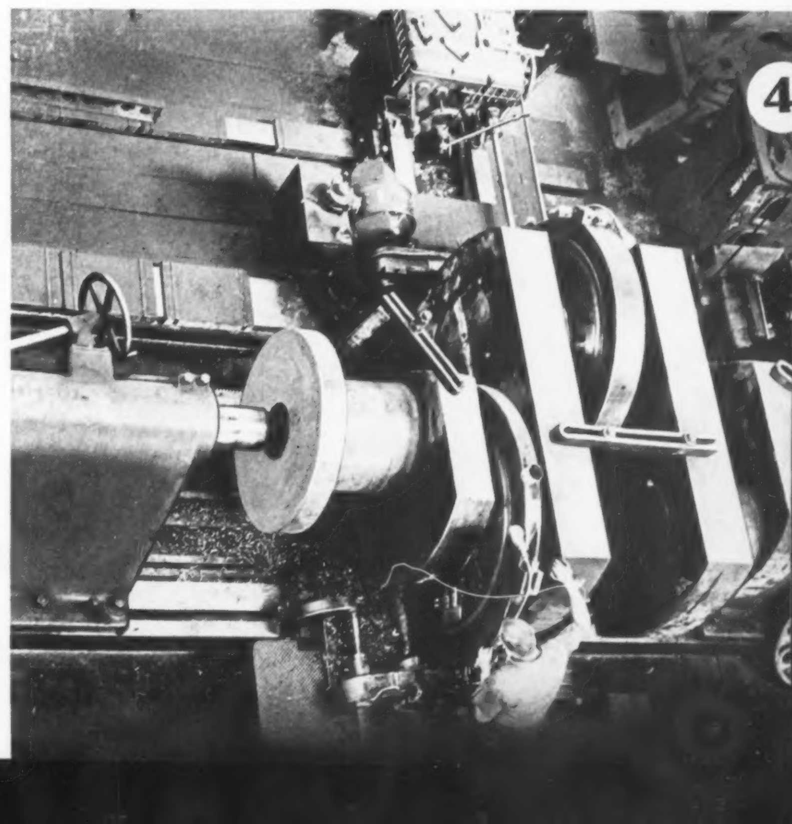
matic jacks. The stiffeners are tack-welded to the plate by means of manual equipment.

The plate, with the required number of stiffeners tack-welded to it, is next moved to the center of the machine, where it is placed on a table that can be tilted to an angle of 45 degrees, as shown, to position the plate for straight down welding by a welding head. This head travels automatically across the top of the machine frame, laying a bead completely along one side of each stiffener. The table is then tilted in the opposite direction for welding the other side of the stiffeners by means of the same welding heads.

The successive plates are finally moved to the stand at the right-hand end of the machine, where as many plates as may be required for a complete bulkhead or shell section are butt-welded together. Pneumatic jacks are also used at this point to hold the plates securely in line.

Of special interest in the machine shop is the Niles machine illustrated in Fig. 4, which is employed for simultaneously turning two crankpins on the crankshafts for Sun-Doxford Diesel engines. Crankshafts for this type of engine are built up from individual crankpins, journals, and crank-arms. The crank-arms are bored and shrunk on the turned pins and journals. Sections of a crankshaft are built up to include one journal and three crankpins prior to the finish-turning of the crankpins, three such sections being later built up into a complete crankshaft; for example, the crankshaft for a six-cylinder engine has eighteen crankpins.

Fig. 4. Two Crankpins of Each Crankshaft Section are Simultaneously Finish-turned in This Niles Machine by Two Tool-heads Revolving around the Stationary Crankpins



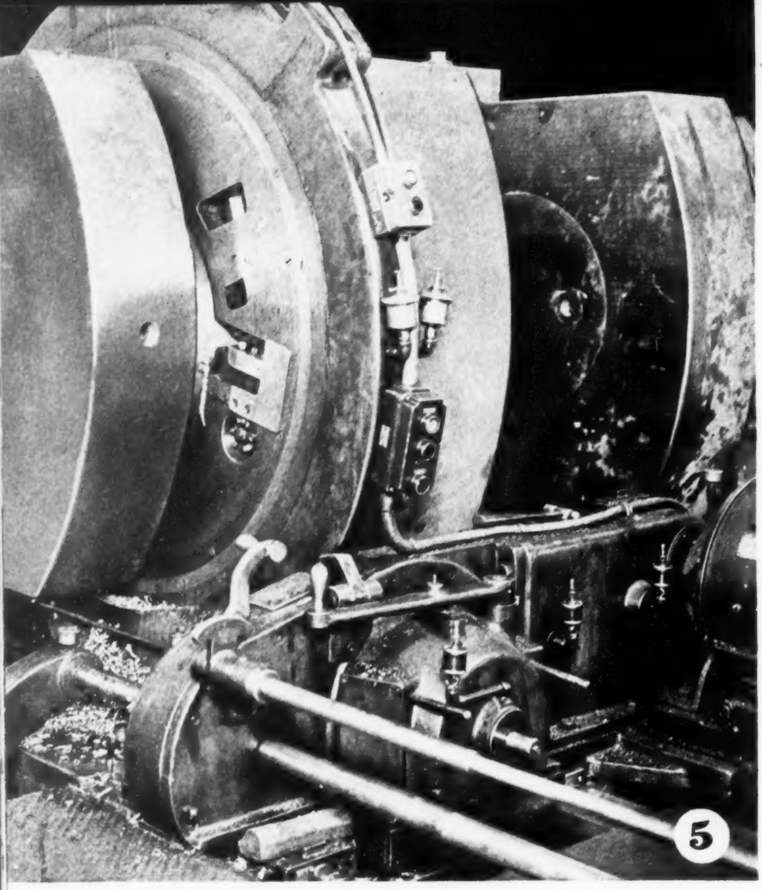
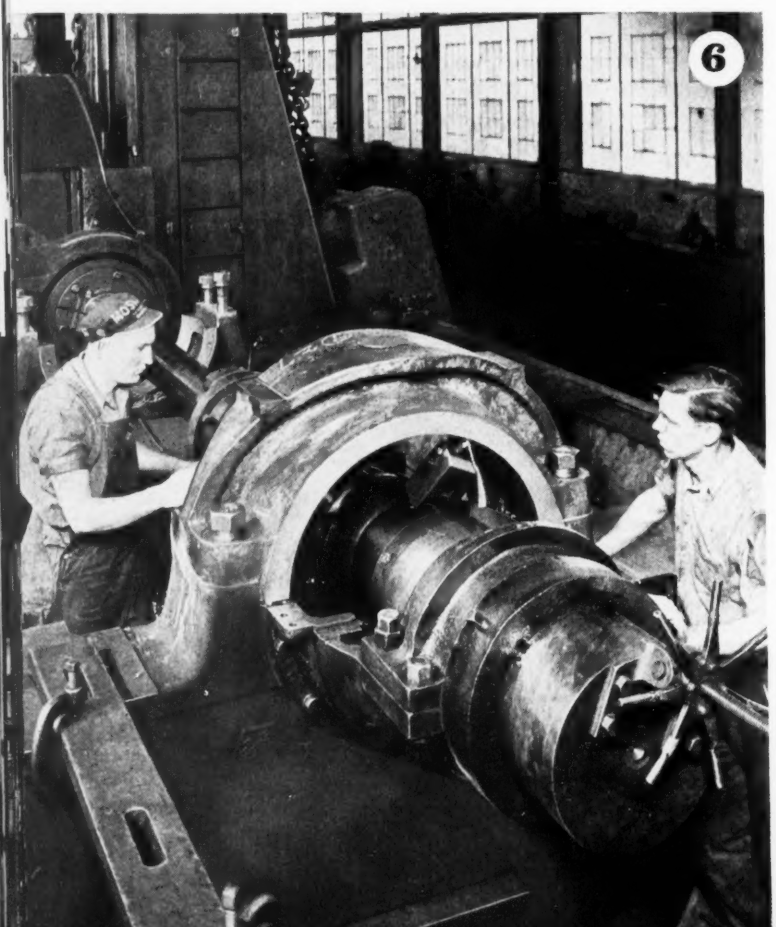


Fig. 5. Close-up View of One of the Tool-heads on the Crankpin Finishing Machine, Showing Split Design which Enables One-half of the Tool-head to be Swung upward for Loading and Unloading the Work

Fig. 6. Boring a Spherical Bearing in the Forward Section of a Large Engine Bed-plate to Receive a Member of Corresponding Shape that Supports the Crankshaft



In this crankpin finishing machine, the crankshaft section remains stationary while cuts are taken by tools mounted in heads that revolve around the crankpins. From the close-up view of the tool-head shown in Fig. 5, it will be seen that the head is split through the center and hinged so that it can be swung upward for loading and unloading the crankshaft. The work is supported between centers for the operation. A crankshaft section such as illustrated weighs about 20 tons and is lifted into and out of the machine by means of an overhead crane.

Tools are mounted on both sides of the tool-head to provide for machining the crankpin the full distance between the crank-arm cheeks, part of the surface being machined as the tool-head moves from left to right and the remaining portion as the head moves from right to left. At the end of each complete feeding movement, the tools are fed to depth by the operator's applying a wrench to the special nut seen just below the tool-holder. Three tools can be applied simultaneously on each side of the tool-head, but it is customary to use only one tool on each side. The tool-heads are run at speeds from 25 to 40 feet a minute.

Crankpins are turned to size within plus or minus 0.001 inch, and a similar tolerance is specified for both roundness and parallelism. In the illustration shown, the crankpins are being turned to a nominal diameter of 24 inches. For the final finishing cut, a gooseneck type of tool is used. The crankpins are later hand-lapped.

The journals of a crankshaft are finish-turned in the Niles lathe illustrated in Fig. 3, which has a swing of 120 inches. This operation is performed after complete assembly of the sections that make up the crankshaft, so as to insure close parallelism of all journals. The crankshaft seen in this lathe was produced for a 6600-horsepower engine.

The frame for Diesel engines built at this shipyard is generally fabricated completely from welded steel, except for the bearings provided for the crankshaft journals. These bearings are castings that are welded into the steel housings, as seen in Fig. 6. This illustration shows an operation on a Sellers boring mill in which a spherical surface is being turned in one of the bearings and in its mating cap.

The outer end of the boring-bar is rigidly supported in a fixture mounted temporarily on one side of the bearing. The tool is contained in a holder that is swiveled to feed the tool through the required arc across the spherical surface. The feed-

ing action occurs each time that an arm on the star-wheel seen in the right foreground, strikes the bar extending from the left, which is mounted on the engine bed. Seven revolutions of the boring-bar are required to impart one revolution to a nut mounted on a feed-screw connected to the swiveling tool-holder. With this arrangement, fine feeds can be obtained for finishing the bearing surface to the high degree required. In the operation illustrated, the bearing seat is being finished to a diameter of 33 3/8 inches within plus or minus 0.002 inch.

The structural-steel engine member here being machined is the forward-section bed plate for a 6600-horsepower engine. It is 20 feet long by 13 feet wide by 5 feet high. The bed plate is supported on two tables positioned on the floor plate of the boring mill. There are three spherical bearings on this bed-plate section.

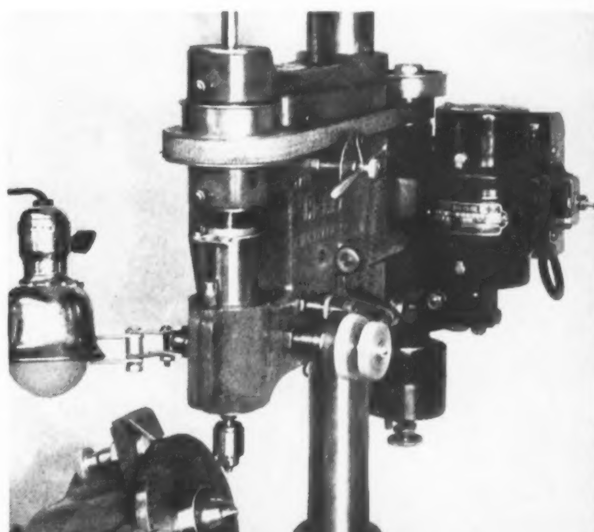
Drilling Holes Only 0.006 Inch Diameter

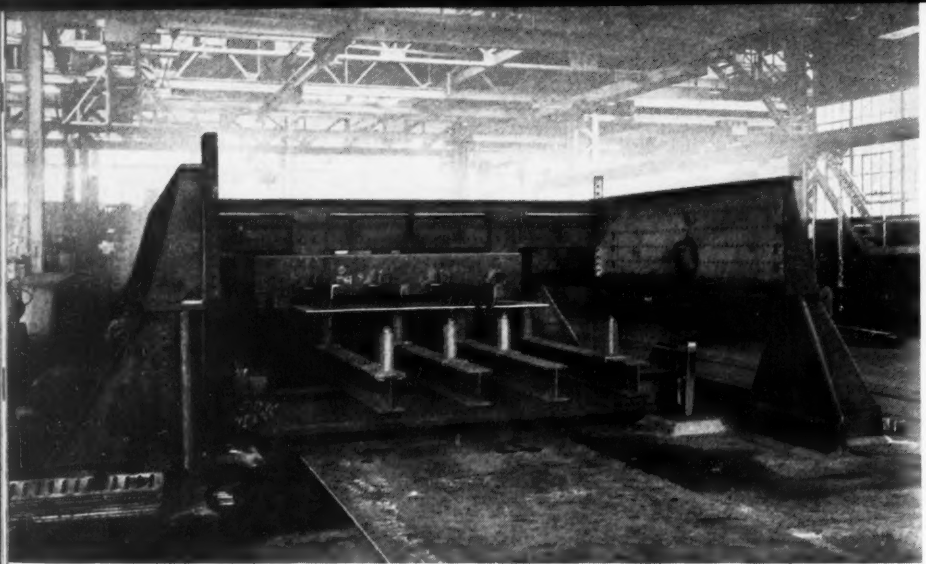
HOLES as small as 0.006 inch in diameter are drilled through the nozzles of fuel injectors at the Diesel Engine Division of the American Locomotive Co., Auburn, N. Y., by means of the equipment shown in the illustration. The minute drill is operated on the step drilling principle, being reciprocated up and down during the operation to free the chips and enable lubricant to be applied until the nozzle section has been completely drilled through. The section is about 3/32 inch thick. The drill is flat on the end instead of being pointed, and has a flute that extends upward from the point for a distance of 7/16 inch.

Two fuel injection nozzles are seen lying on the table of the machine and there is a third on the index-head. Ten holes are generally drilled around a nozzle, the required spacing being readily obtained by means of the index-head. The angularity of the holes with respect to the center of the nozzle varies in different parts. The index-head is therefore of a design that can be accurately tilted into the required angular position. The nozzles are made of steel and are heat-treated after drilling.

The reciprocating movements of the drill are obtained by means of a ratchet mechanism which is driven separately from the main drive, by means of a small Dumore motor. The downward feed is obtained through the tension applied by the coil spring seen in the illustration. Up-and-down movements of the drill spindle are effected every six seconds. Lubricant is brushed on the drill at each withdrawal from the hole. The drill spindle runs at about 30,000 revolutions per minute.

Drilling Holes Only 0.006 Inch in Diameter through the Nozzle of Fuel Injectors for Diesel Engines. The Hairlike Drill is Flat on the Cutting End and is Run at a Speed of 30,000 Revolutions per Minute





Fabricating

Fig. 1. Special Equipment Developed for Locating Serrated Angles Relative to the Plates and Clamping Them in Position for Tack-welding

THE Dravo Corporation, Pittsburgh, Pa., was a pioneer in the use of steel for barges and other craft intended for operation on the Mississippi River and its tributaries. More recently this concern has been a leader in the development of similar all-welded craft for service on the Eastern Seaboard and rivers. Production-line methods developed for the fabrication of marine equipment of this type enabled the company to produce ninety-five welded hulls and nine riveted hulls in 1936, and ninety-two welded hulls and three riveted hulls in 1937. Prior to 1936 practically all such hulls were riveted.

Special equipment had to be developed to meet the particular requirements of arc-welding operations and, in addition, a large building was erected for the complete construction of large hulls indoors, independently of weather conditions. This building has proved an important factor in meeting working and delivery schedules because it has eliminated all interruptions due to rain, snow, and severe temperatures. The new equipment improved the accuracy of the finished hulls, facilitated the speed of assembly, and eliminated, to a very great extent, the necessity of making overhead and vertical welds.

The construction of any type of hull involves the fabrication of a large piece of equipment from many relatively small plates and structural shapes. For example, the sides of a coal barge 175 feet long by 26 feet wide by 11 feet deep consist of box sections approximately 30 feet long by 3 feet wide by 11 feet deep, weighing about 8 tons each. These sections are strengthened by side frames which are spaced about 2 feet apart. As produced in the structural shop, the side frames are preassembled in jigs and welded in one operation. They are then welded to the plates to form box sections.

Bottom sections consist of plates that have transverse braces made by shearing structural channels into two symmetrical pieces or angles on which the web is cut to a sawtooth outline, as seen in Fig. 2. These sawteeth or serrations extend from the flange a distance of about two-thirds the depth of the original channel. The serrated ends are welded to the plate.

The problem of standing each serrated angle on edge and spacing it accurately for the welding operation required the development of the fitting table illustrated in Fig. 1. The plates on which the serrated angles are to be welded are placed in a jig that rests on a series of roller casters, supported, in turn, as shown, on a beam framework, which can be raised by means of hydraulic jacks. The serrated angles are entered into slots in overhead spacing beams prior to raising the bed which holds the plate. With the jacks raised, the assembly is clamped for tack-welding the angles to the plate.

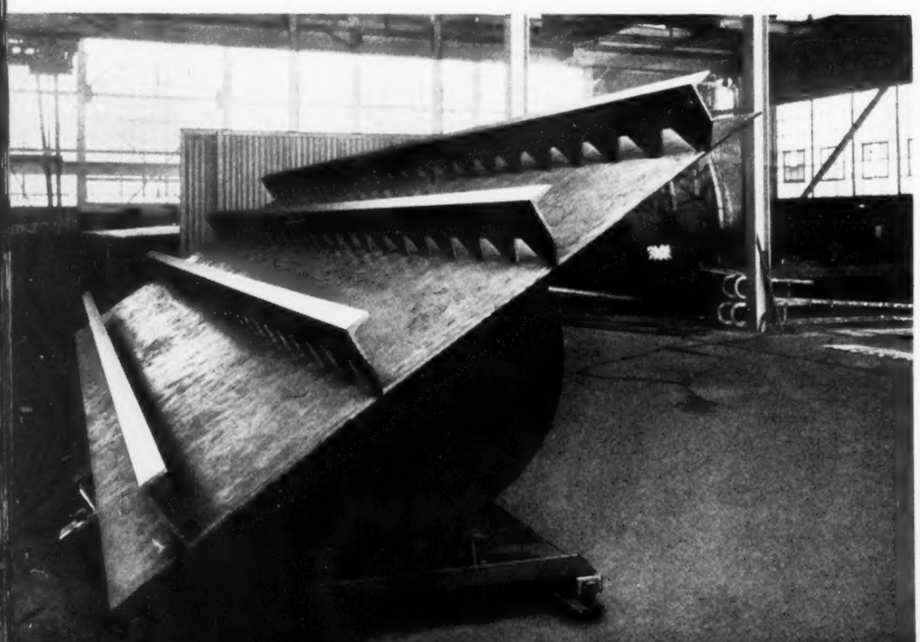


Fig. 2. Tilting Table which Facilitates the Welding of the Serrated Angles to the Bottom Plates of Barges and Scows

Welded Barges

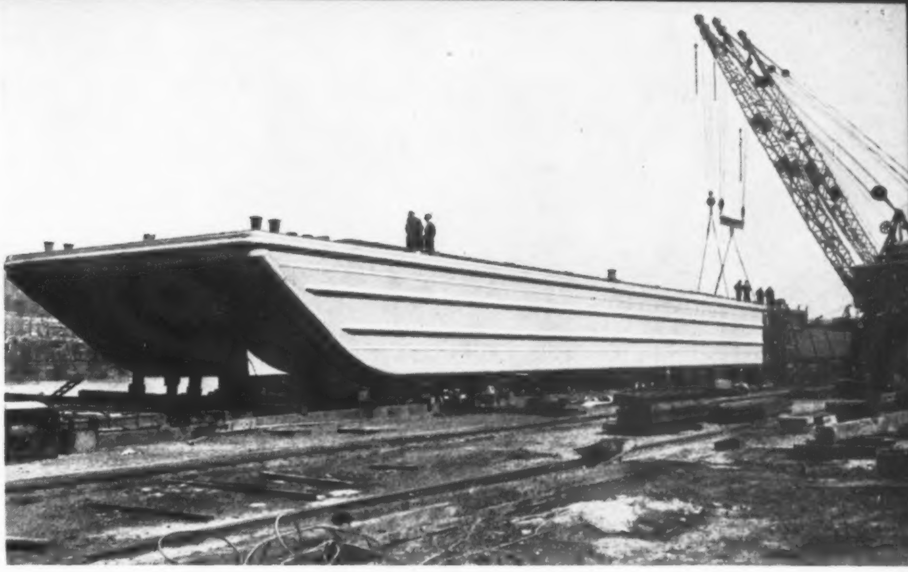


Fig. 3. Dump Scow of All-welded Steel Construction which has an Over-all Length of 206 Feet and a Capacity of 1200 Cubic Yards

The tack-welded assemblies are taken to tilting tables of the construction shown in Fig. 2, by means of which the sections can be placed at an angle of about 45 degrees to insure that the weld metal will flow into the crater formed by the arc instead of away from it, as is the tendency in overhead or vertical welding. The serrated angles are welded to the plate by depositing a continuous bead entirely around the portion of the web that comes into contact with the plate. After the welding has been completed on one side of the serrated angle web, the table is tilted through an angle of 90 degrees to bring the other side of the web upward for welding the opposite bead. Rake frames for the ends of barges are also welded in jigs in the structural shop and prefabricated in large units.

The different barge sections are then transferred on cars to the assembly plant, where the major part of the barges, towboats, etc., are completed under cover. The barge assembly line is housed in a two-bay all-welded steel building, one bay of which is used for preliminary assemblies and the storage of fabricated sections, while the other provides space for the complete erection and welding of three barges by production-line methods.

In the first position of the assembly line, the middle body of the barge, consisting of the bottom and side sections, is erected and tack-welded together on permanent skids. Following this, the barge is raised from the skids by hydraulic jacks and placed on transfer cars that move it sidewise to the second position, where the rake ends are added and the welding is practically completed. After moving the barge to the third position in the same manner, the final welding is performed and the barge is tested and painted.

Upon completion, the barge is moved out of the building and then conveyed to the launching skids. The usual elapsed time between the starting on the assembly line of a barge weighing about 150 tons, and its launching, ready for service, is ten days.

While the assembly shop has been designed primarily for the production of vessels of a standardized type, it can also be used for unusual types of equipment. Two of the largest all-welded steel dump scows ever built in an inland waterway shipyard were produced for the Merritt, Chapman & Scott Corporation, of New York City. These scows measure 206 feet long by 40 feet wide by 14 feet deep, and have a capacity of 1200 cubic yards.

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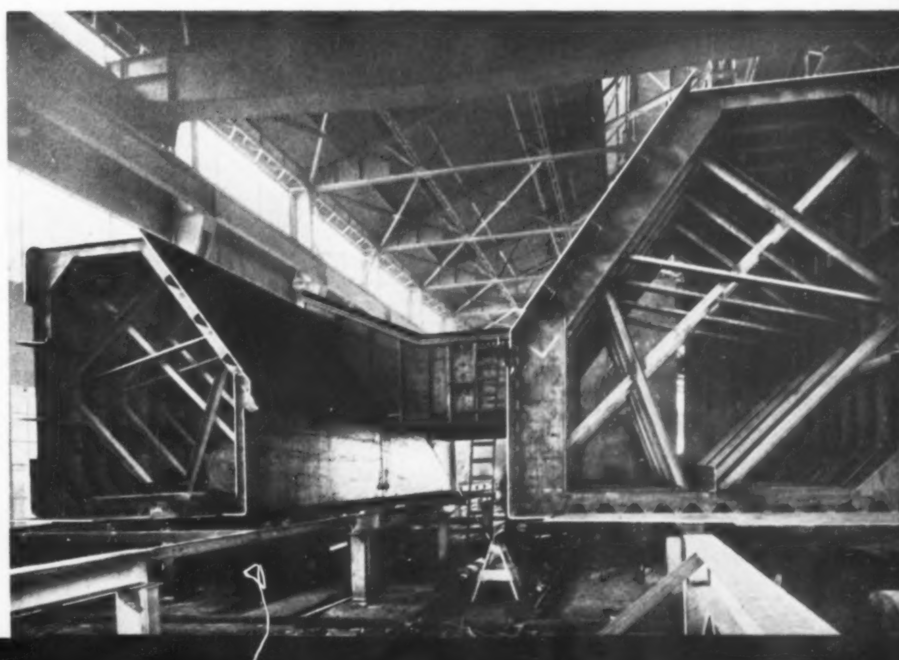
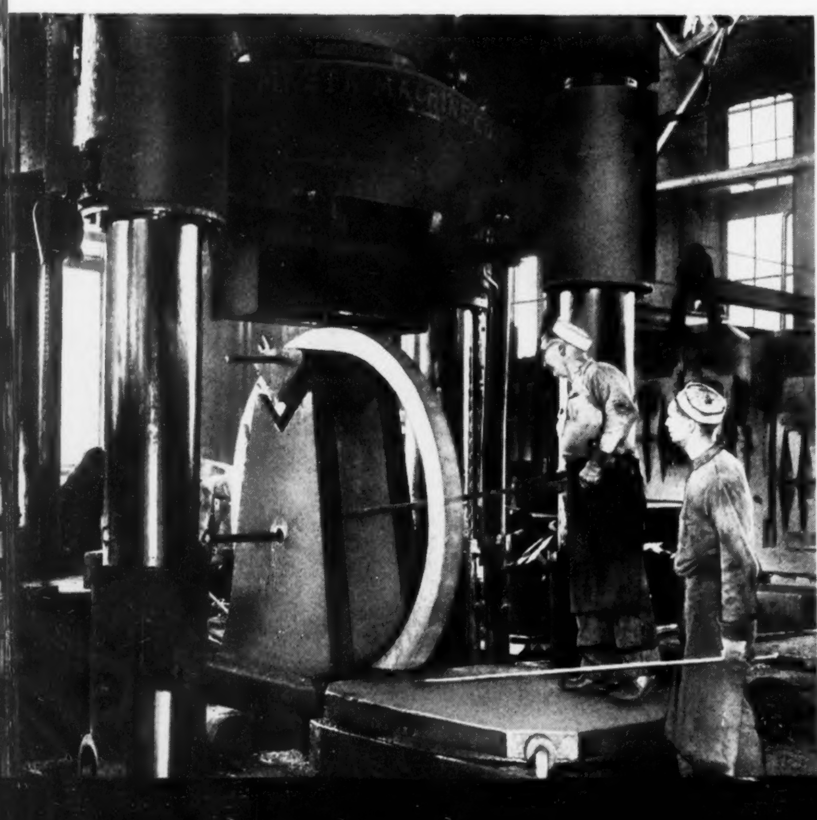


Fig. 4. View in the Erection Shop of the All-welded Side-wing Box Sections of the Large Dump Scow Shown in Fig. 3

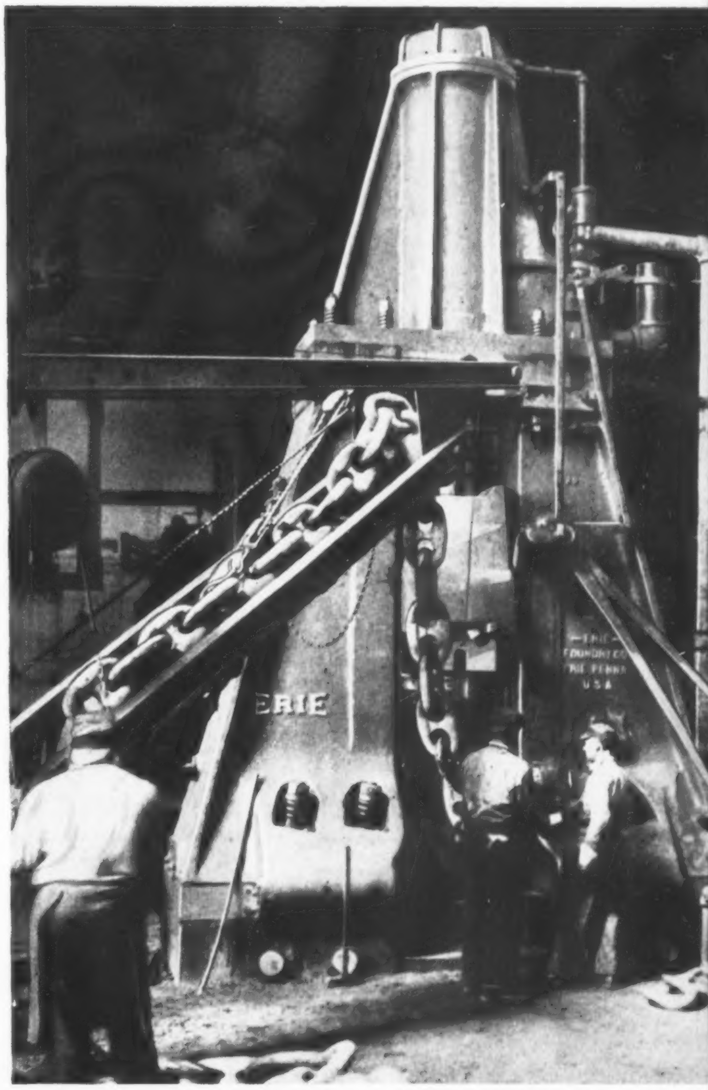
Striking Views in Navy

(Left) Huge Castings and Forgings are Required in the Construction of Ships. The Rudder Frame Steel Casting Here Shown is of Especial Interest Because of Its Length and Thin Sections. This Casting is over 23 Feet Long by 7 Feet 6 3/4 Inches Wide and Weighs 12,300 Pounds. It was Produced by the Randupson Process in the Foundry of the Birdsboro Steel Foundry & Machine Co.

(Lower Left) Forging a Large Solid Ring at the Naval Gun Factory under a 2000-ton Mesta Press. This Ring was Produced from a Solid Slab that was Split in the Center and Gradually Expanded into a Large Circle. (Lower Right) Preliminary Stage in Forging a Heavy Billet into a Gun Part under the Same Press as Shown in the View at the Left

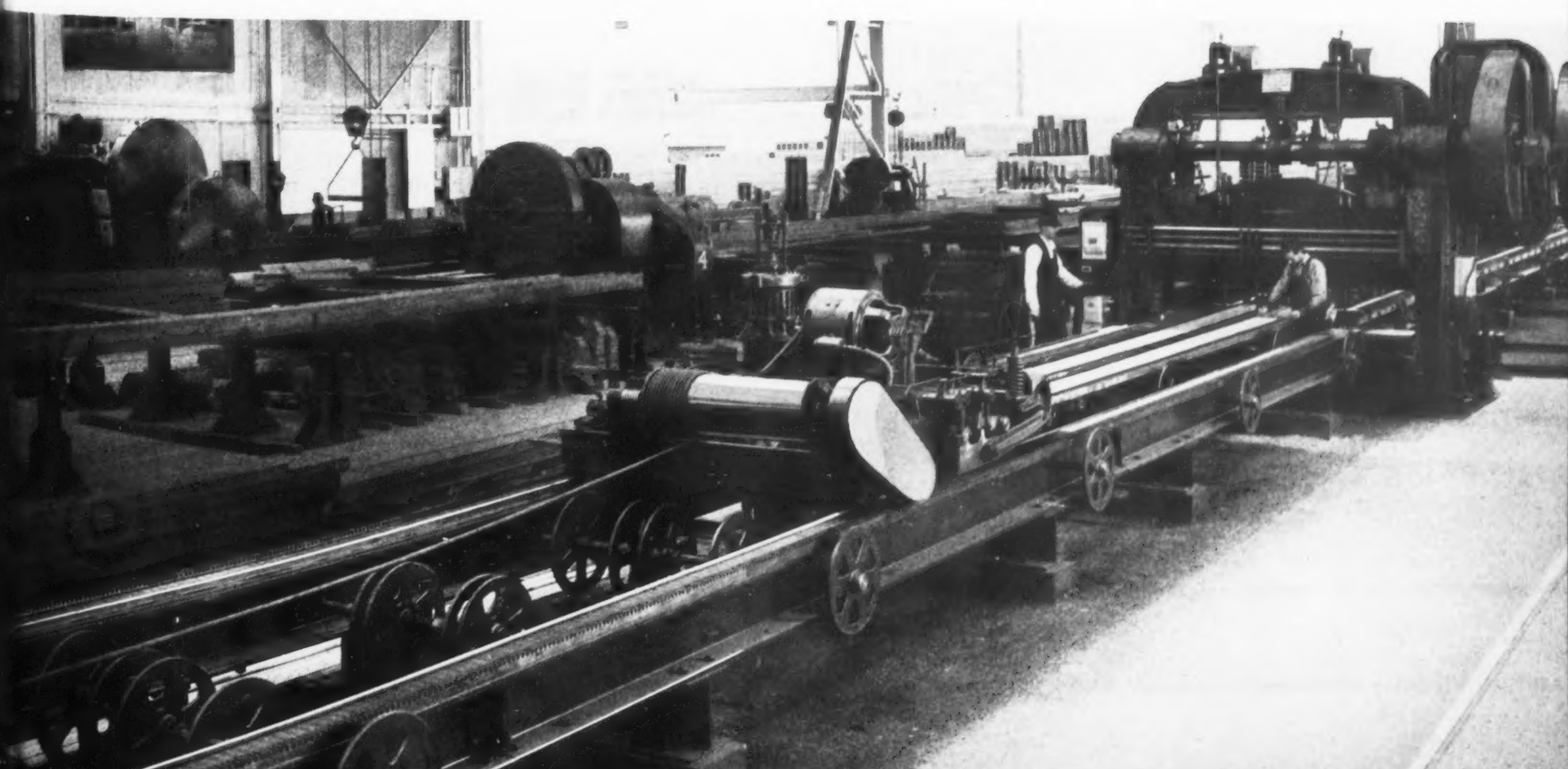


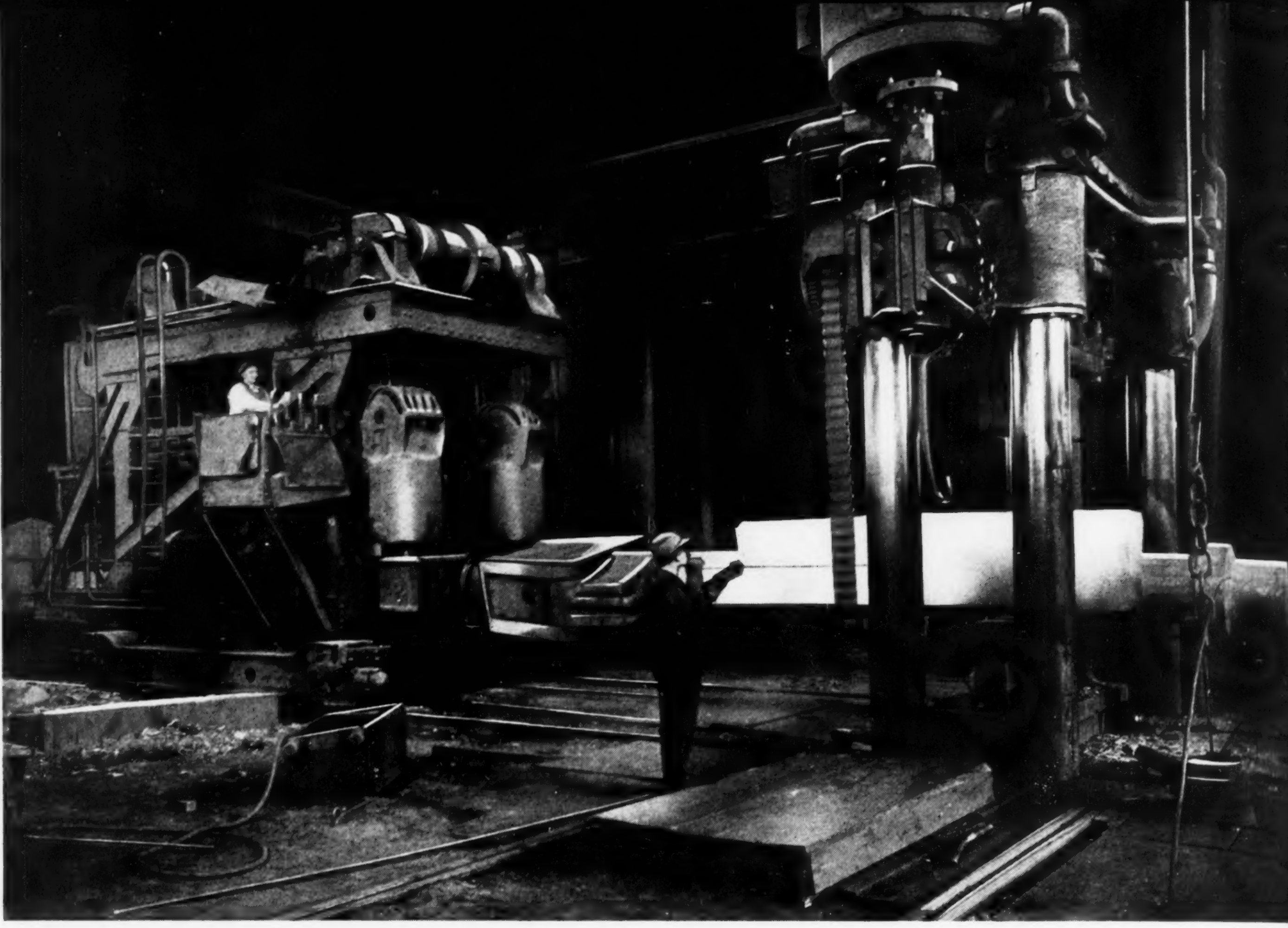
and Private Shipyards



(Right) Assembling Anchor Chain at the Boston Navy Yard, Each Link being Made from Two Separate Forgings of Alloy Steel. One of These Forgings has Two Tapered Prongs, and the Other Corresponding Sockets. The Sockets of One Forging are Closed on the Prongs of the Other under a 10,000-pound Erie Steam Hammer. As the Socket Forging Cools, the Sockets Contract on the Prongs and Produce a Strong Connection

(Below) Twenty-eight Holes of 1-inch Diameter can be Punched through Ship Plates Simultaneously by the Machine Here Shown, which is Furnished with an Automatic Spacing Table for Locating the Plate beneath the Punches as Desired. This Table can Handle Plates 75 Feet Long. The Equipment was Built by the Thomas Machine Mfg. Co. for the Moore Dry Dock Co.





Crankshafts for Driving Ships

CRANKSHAFTS for Diesel engines used in marine service evoke great interest in mechanically minded men, not only because of their large size, but also because of the high degree of accuracy to which they must be machined. Crankshafts with main and crankpin bearings as large as 24 inches in diameter and with an over-all length of 40 feet, for example, have been forged and finished in the shops of the Erie Forge Co., Erie, Pa., with the bearings concentric and parallel within 0.001 inch and with the entire crankshaft straight within 0.002 inch. Crankshafts of the dimensions given weigh approximately 50,000 pounds and are used for driving large passenger vessels, merchant marine ships, fuel oil tankers, and colliers.

The forging of large crankshafts in the plant mentioned is a most spectacular operation. Huge ingots such as seen in Fig. 1, after having been heated to about 2100 degrees F., are drawn out to the desired length and rough diameters by the 2500-ton United press (now built by the Chambersburg Engineering Co.) shown in the heading illustration. The ingot, which may weigh as much as 175,000 pounds, is handled with comparative ease by the big "manipulator" at the left which is used in conjunction with two overhead cranes of 50 tons capacity that support the ingot on one or both sides of the press. The manipulator is electrically driven and controlled, but it is provided with gripping tongs that are operated by compressed air. Hydraulic power is used for effecting the downward movements of the press ram in shaping the forging, and steam for effecting the upward strokes.

The manipulator moves on tracks to adjust the ingot back and forth in the dies. It can also move the ingot vertically and turn it around a complete circle. Endless metal belts are suspended from the overhead cranes to support the ingot, assist in rotating it between the dies, and maintain balance while moving the forging laterally.

When the ingots reach the forge shop, they are of octagonal or corrugated round cross-section and

Fig. 1. Ingots Ranging up to 175,000 Pounds in Weight are Used for the Forging of Crankshafts for Marine Diesel Engines. Only 12 to 30 Per Cent of the Ingot Stock is Left in the Finished Crankshaft

range up to 64 inches in diameter and 14 feet in length. They are cast with the largest diameter at the upper end. Both ends of the ingot are cropped off after heating for the forging operation, so as to insure the use of solid metal only for the crankshaft. Complete forging of the crankshaft is performed between flat dies, cylindrical surfaces being formed by rotating the stock between successive "squeezes" of the dies. A rectangular cross-section for the cranks is pressed off center.

The larger crankshafts are forged from carbon steels of various specifications. However, alloy steels are generally required for the crankshafts of the smaller high-speed Diesel engines, such as are used in submarines. The alloy steels used for crankshafts include straight nickel, nickel-chromium, chromium-molybdenum, nickel - chromium - molybdenum, chromium - vanadium - molybdenum and chromium-vanadium steels. Tensile strengths range from 60,000 to 150,000 pounds per square inch.

It is the practice to forge the whole length of a crankshaft on each heat, although three or more heats may be performed prior to the final operation, in order to obtain the metallurgical conditions desired and to avoid the hazard developed by having one part of the length hot and another part cold. In the forging operation, one man controls the press ram, another the movements of the manipulator, and two others the overhead cranes. The manipulator has a capacity of 20 tons, and is believed to be the largest equipment of this type in the world that is used in forge work.

Upon the completion of the forging operation, crankshafts of carbon steel are annealed at a temperature of between 1475 and 1500 degrees F. Alloy steel crankshafts are annealed at a temperature first of between 1500 and 1600 degrees F. and then between 1425 and 1475 degrees F.

The next step in crankshaft manufacture is to form the cranks. This is done by cutting narrow slots into the rectangular stock, allowing enough metal to form the journals. The cuts are taken by a huge cold-sawing machine to form lugs of the required width. Then a series of holes is drilled across the spaces between the lugs that are to be left for the cranks. The drilled sections are next knocked off, after which the crankshaft is rough-turned at the points from which the drilled sections were removed, and also at one end, as shown in Fig. 2. The crankshaft is now ready for twisting the cranks into the required angular planes with respect to the crankshaft axis.

The crank-twisting operation is also performed in the hydraulic press seen in the heading illustration after the crankshaft has been heated locally to a temperature of 2200 degrees F. at the point where it is to be twisted. This heat-treating is performed in a special furnace, care being taken to see that the section is well "soaked" in order to avoid tearing off during the twisting. With the smaller crankshafts, however, the entire part is heated for this operation, as it is then possible to twist all of the cranks in a continuous operation.

Twisting is performed with one crank held firmly

Fig. 2. Blocks of Metal are Removed from the Rectangular Section of the Crankshaft Forging by Sawing and Drilling in Order to Prepare the Crankshaft for Twisting the Cranks to the Required Angles

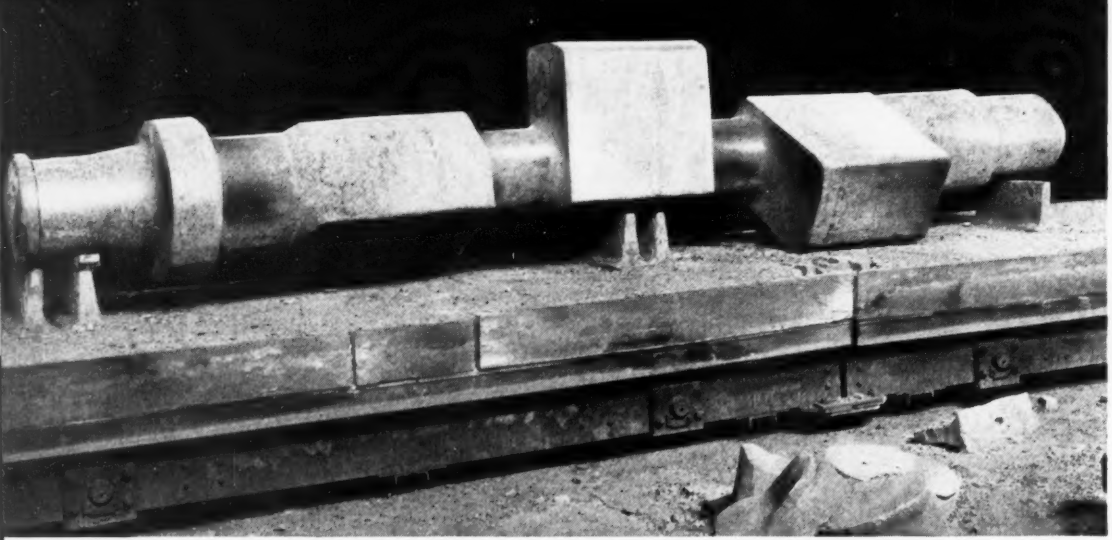


Fig. 3. A Three-crank Crankshaft after the Twisting Operation, Lying on a Flat Car Ready for Annealing

CRANKSHAFTS FOR DRIVING SHIPS

between the dies of the press and one end of the crankshaft held in the tongs of the manipulator, by pulling upward on a large ratchet type of wrench fastened to the crank to be twisted. The handle of this wrench is pulled upward by a 75-ton overhead crane. Twisting occurs in the journal between the two cranks, and the operation must be performed slowly in order to avoid shearing. Gages are used to determine when the proper crank angle has been produced. Fig. 3 shows a crankshaft forging on which the three cranks have been twisted into the required angular planes.

Important factors in the twisting operation include a smoothly finished journal, a thoroughly heated journal, and an uninterrupted twisting operation. When one crank has been twisted, the crankshaft is annealed and then reheated for twisting the next crank. Crankshafts have been made with as many as ten cranks, depending upon the number of cylinders in the Diesel engines for which the shafts were intended.

After all the cranks have been shaped to the required angles, the entire crankshaft is annealed by loading on a flat car, as shown in Fig. 3, and pushing the car into a long oil-fired furnace. Alloy steel crankshafts are rough-machined after the annealing and then heated, quenched, and tempered before the roughing operations are resumed. Quenching pits up to 65 feet deep are available for the heat-treating processes. Test bars are removed from the heat-treated crankshaft and sent to the metallurgical laboratory to determine the physical characteristics.

At the end of the heat-treating process, the main crankshaft bearings are rough-turned in a lathe set up as shown in Fig. 4. Then the excess stock between the cheeks of each crank is removed by drilling a series of holes close together down both sides of the cheeks and across the top of the journal, in the same manner as stock was removed from between the journals prior to the twisting operation. The crankpins are next rough-turned. This operation is performed by either of two methods. The first is by the use of a standard lathe of

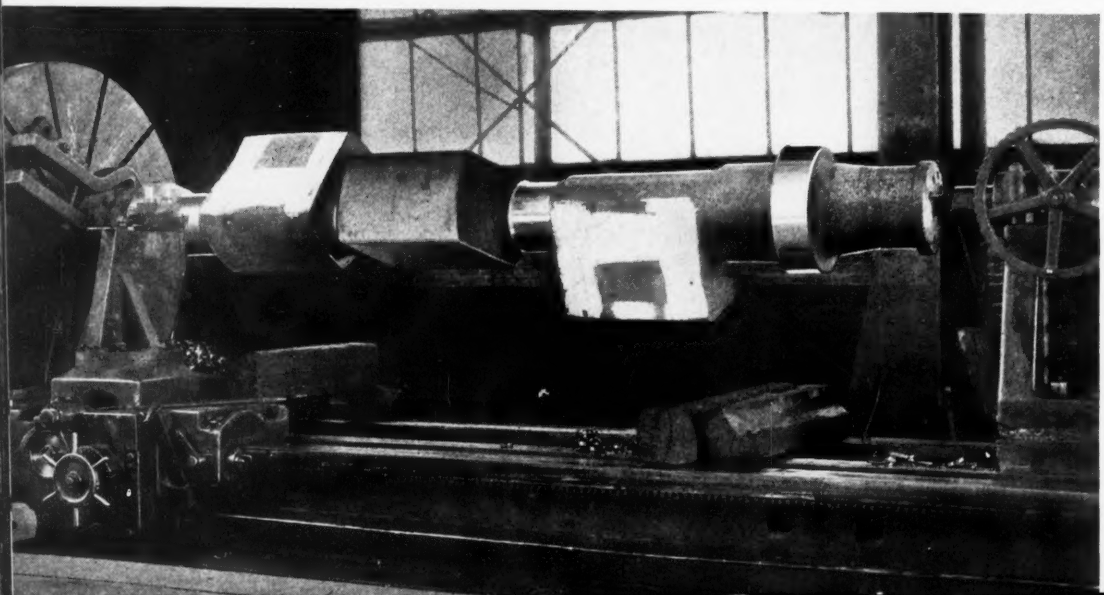
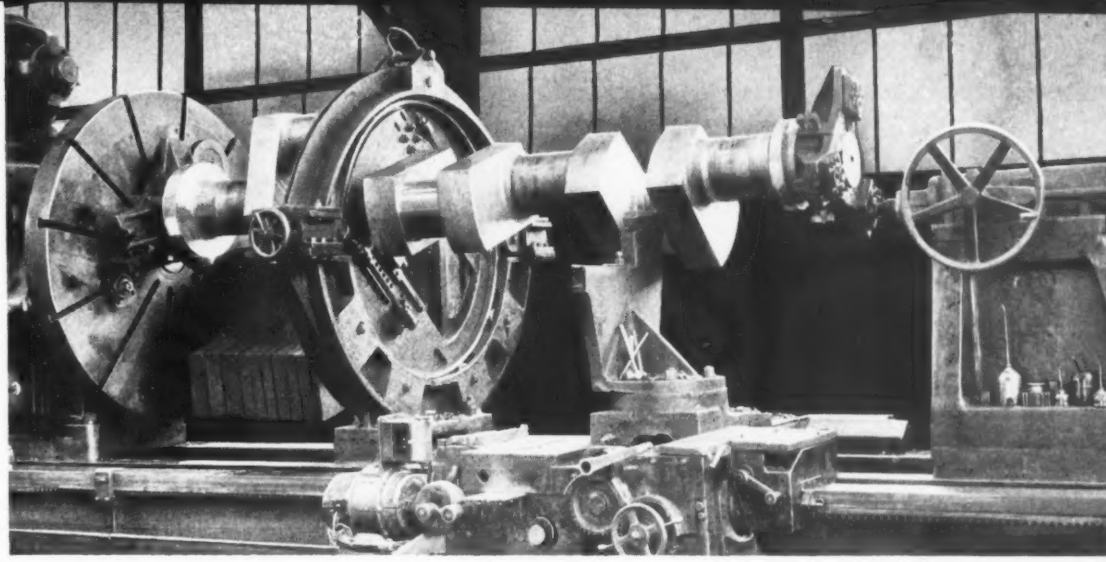


Fig. 4. The Main Bearings are Rough-turned as Shown previous to Sawing and Drilling out the Crank Lugs to Form the Crankpins

Fig. 5. Crankpins are Machined in a Lathe Arranged as Shown or in a Special Machine with a Revolving Tool-head



large size, the crankshaft being rotated about the center of the particular pin to be machined and cuts being taken by tools mounted on a carriage in the conventional manner. In the second method, a machine is used which is equipped with a revolving tool-head, the crankshaft remaining stationary for the operation.

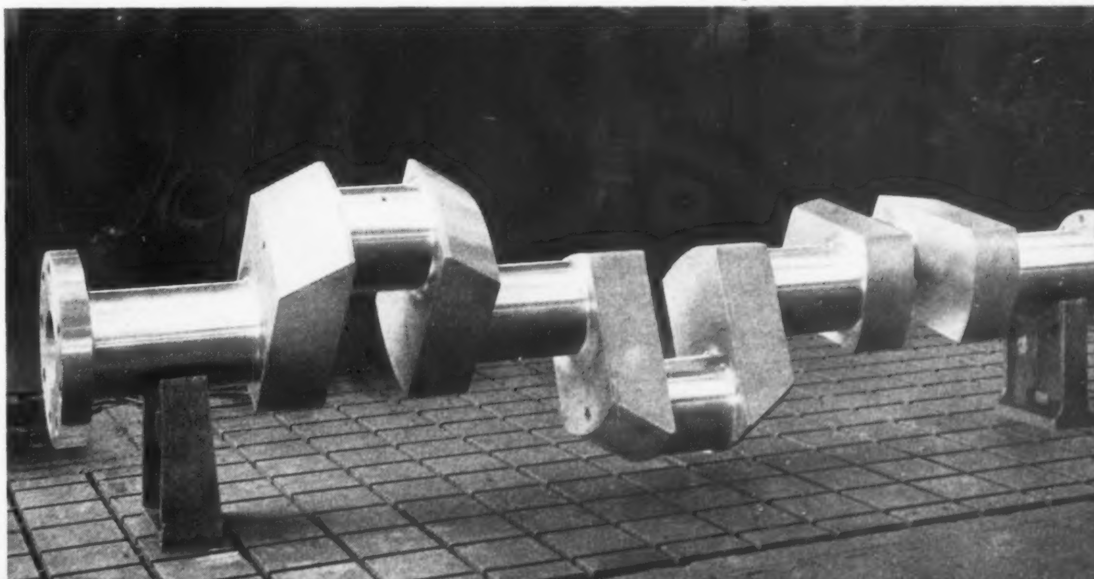
Finish-turning of the bearings and crankpins follows. Fig. 5 shows a lathe employed for finishing the crankpins. It will be seen that a fixture is mounted on the tailstock end of the crankshaft and on the faceplate of the headstock to provide for revolving the work around any of the three crankpin centers. A large steadyrest that can be adjusted to suit the various centers about which the work must be revolved in machining the different crankpins supports the crankshaft on one of the main bearings. Counterweights are attached to the headstock to insure smooth rotation in turning crankpins. It will be observed that the lathe carriage has an individual rapid-traverse motor drive.

Carbide tools are used in machining alloy steel crankshafts, because the tool edges must stand up for the full length of the journal surfaces, in order to obtain the required accuracy. The hardness of these surfaces ranges up to 250 and 260 Brinell.

The flat outer surfaces of the cranks are finished on planer type milling machines after all the main and crankpin bearings have been turned to within 1/8 inch of the finished diameters. This operation could not be performed after complete turning, because the strains that would be released by the probable removal of more surface metal from one flat than from the opposite flat would cause distortion of the crankshaft, forming a long arc or bow in the length of the piece, and necessitating rectification to a straight line.

Prior to taking the final turning cuts, the crankshaft is either given a stabilizing operation in a low-heat furnace or allowed to season for a prescribed period. After the finish-turning cuts have been completed, the crankpins and main bearings are lapped by lathe operators holding wooden forms over the revolving bearings and applying emery

Fig. 6. Crankshafts for Diesel Engines Must be Accurate as to Parallelism and Concentricity of Crankpins and Main Bearings



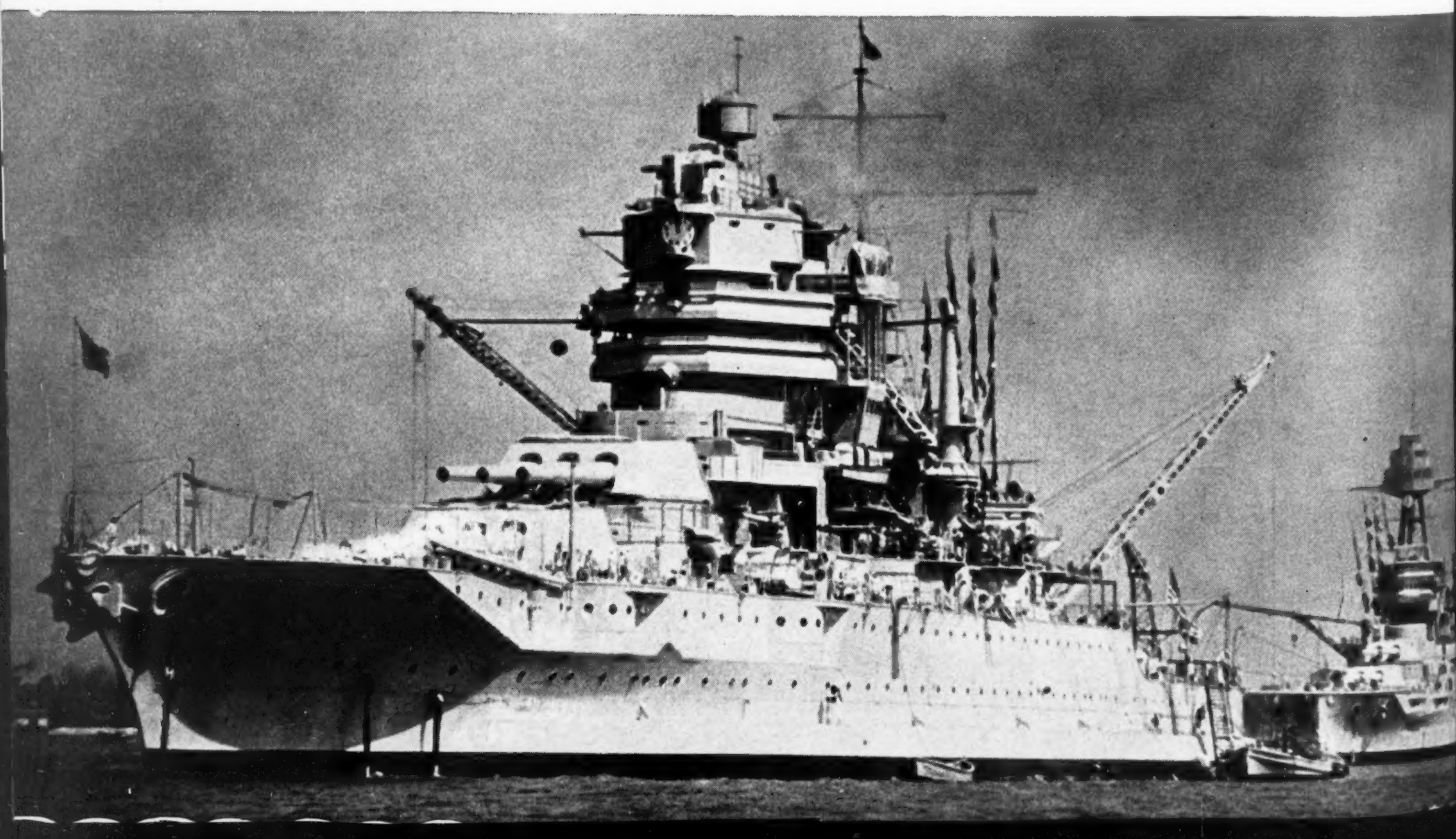
cloth, leather, or lead between the forms and the rotating surfaces. Lapping is a major operation, days being required for lapping all of the bearings on a large crankshaft.

When a crankshaft has been completely lapped, it reaches the inspection floor plate seen in Fig. 6. All crankpins and bearings of the average crankshaft must be concentric and parallel within 0.001 inch, a tolerance of extreme accuracy when the large diameter of the journals is considered. The phase angle of the cranks must be correct within 1/4 degree on the circle. The axes of all shaft journals must be parallel within 0.001 inch, and the axes of the crankpins must be parallel with the journal axes within 0.0015 inch in 10 inches. The face of the end flange must be square with the axis within 0.001 inch on the diameter. Other tolerances are fully as close as these.

All crankshafts are inspected for static balance at the plant of the Erie Forge Co. and for dynamic balance in the customer's plant. Corrections for static unbalance are seldom necessary, because close adherence to the tolerances specified insures proper distribution of the metal. As an example, four bored submarine-engine crankshafts, 40 feet long and weighing approximately 10,000 pounds each, were recently finished with a maximum difference in weight of less than 7 pounds. This is particularly remarkable because of the number of dimensions inside and outside that had to be exact duplicates in order to produce such an agreement in weight.

A finished solid crankshaft weighs only about 30 per cent as much as the ingot from which it was produced, and a bored crankshaft as little as 12 per cent of the weight of the ingot necessary for safe production.

This article has given a brief outline of the more important operations involved in making a crankshaft for a large Diesel engine. Many machine set-ups are required that have not been referred to. In fact, a total of 276 machine set-ups were required recently in machining a crankshaft having ten cranks.



Better Steel Castings Result from Having Foundrymen Check Designs

By CARL F. CLARKE, President and General Manager
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Member Steel Founders' Society of America

THERE is probably no single factor relating to the production of high-grade steel castings that is as important as proper design. Most designers possess the knowledge required to proportion steel castings. They know the different shrinkage factors applicable and the standard allowances. They are able to make a design that, theoretically, should produce a sound casting.

Unfortunately, the design problem is not quite so simple as that; there are other important considerations. First, there is the construction of patterns, the order for which may be given either to the foundry or to a commercial pattern shop. If the latter procedure is followed, the patterns may later have to be altered to accommodate them to the foundry methods or to the variables in shrinkage due to design. If the foundry makes the patterns, the buyer knows that they are going to be all that the foundry wants them to be. That saves time and often insures better castings.

Regardless of how perfect the pattern is, however, there remains one matter which, if overlooked, may still spell disappointment—a matter connected with design. Steel casting design details cannot be standardized, but some rules are fairly generally used; however, like all rules of procedure, there are important exceptions. Many of these are learned by the foundryman only after long years of experience. The foundryman has observed the behavior of molten steel in cavities of all kinds of sizes and shapes. By merely looking at a blueprint or pattern, he often knows instinctively whether a given section will run properly in the mold and produce a sound casting. Were he accorded the privilege of examining the pattern and encouraged to suggest any changes that he believed would improve the product, it would result in advantage to both foundry and buyer.

Too often the foundry is given a pattern that, in spite of the application of all the tricks of the ingenious foundryman, is incapable of producing first-quality castings, due to one or two defective features of design. If the foundryman is forced to make the best castings he can from the patterns sent in by the customer, that is one thing; but that procedure is not recommended if the best possible castings are desired. What we are concerned with is a means by which the buyer can communicate to the foundryman his willingness to cooperate in the matter of design.

This situation can be easily brought about. All that is necessary is to send a duplicate set of blueprints to the foundry with a note pinned to them reading something like this: "We are attaching an additional print and ask that you sign and return it as approval of the design, from the standpoint of sound foundry practice. Any suggestions for improvement in the design indicated on this print will be greatly appreciated." That sort of an approach will bring forth wholehearted cooperation on the part of the steel foundryman, who welcomes such opportunities to assist customers in getting the best possible designs.

It cannot always be determined in advance whether a given design, even when initially approved by a competent foundryman, will work out perfectly when the pattern is placed in production. However, an initial casting will usually tell the story. It can be cut up, checked, and tested, so that any design features that are causing trouble, which cannot be eliminated without some change in design, can be detected. Suggestions for alterations in design can then be made to the buyer, and when finally agreed upon, will usually result in more satisfactory castings.

Since a study of blueprints or even patterns does not always reveal the "bugs" in a given design, it would be appropriate for the foundryman to reply to a buyer's invitation for suggested improvements in design in some such manner as this: "Suggested changes are marked in crayon on this drawing. Further changes, helpful to foundry practice, may be suggested during the construction of the pattern or after sample castings have been made."

If the design is beyond the drawing stage and a pattern has been made, the foundryman might reply: "As far as we can determine, the design is satisfactory. However, changes may be necessary after sample castings have been made."

An excellent way to approach this question of proper design for steel castings is to call in a representative from the foundry while the drawing is still on the board and ask for his advice at the start. Many difficulties and much dissatisfaction could be avoided were this procedure more generally followed. Buyers adopting one of the methods suggested for cooperating with the steel foundryman on proper design will undoubtedly find that it pays real dividends in the prevention of delays and in the production of better castings.

EDITORIAL COMMENT

Just exactly what does the increasing tax burden of federal, state, and municipal governments mean to the men and women who get their livelihood by contributing their labor to maintaining what is generally referred to as the American standard of living? Most of the people working in industrial plants believe that they are practically exempt from taxation because they pay little or no direct income tax. They are not aware of the fact that indirect tax burdens are much greater than direct income taxes, and that they pay their share, even if they do not know it.

We Pay Taxes at an Annual Rate of $523 per Family

There are approximately 31,500,000 families in the United States. According to a careful estimate of total government expense in the fiscal year 1937-1938, made by the National Industrial Conference Board, the combined expense of federal, state, and municipal governments was $16,500,000,000. This amounts, on an average, to $523 for every family in the United States—a substantial sum to be charged against the family income. With the expenditures planned for the fiscal year 1938-1939 in effect, this figure will run even higher.

Since there are many families in the United States in very low income brackets—especially in the rural districts—it means that industrial workers, whose income is, on an average, much higher, contribute more than the average quota. Not all of this contribution is paid out directly by the wage-earner himself. A large proportion of it is paid out by his employer. But nevertheless, in effect, it is paid on the wage-earner's behalf, because the tax is paid by the employer for the privilege of doing business and creating employment for labor.

Everyone Who Performs Useful Work Pays the Tax

There are many manufacturing companies who pay anywhere from $350 to $600 annually in taxes for every man and woman in their employ. Obviously, if these taxes were not so high, part of this money could be applied to higher wages or increased employment.

The wage-earners in the United States should not fool themselves with the belief that they live under a government that collects very small taxes from them. On the contrary, they live under a government that spends more money per person than any other government in the world; and all the money being spent must, in the last analysis, be paid by those who perform useful work in industry or agriculture.

Employers who recognize these facts could perform no greater service to their employes than by conveying to them information pertaining to the hidden taxes that they pay—taxes that not only reduce the wage-earner's income, but also reduce the opportunities for employment.

A wise old philosopher once said, "He who has imagination without knowledge has wings without feet." He is up in the clouds—but in mechanical work, whether in the designing department or in the shop, it is necessary to keep both feet firmly on the ground.

He Who Has Imagination without Knowledge Has Wings but No Feet

Competent designers and builders of mechanical equipment by necessity must be practical. They are competent because they are never above learning from others. They are always eager to find out what other engineers or shop men may have discovered.

The easiest way to profit by the experiences of others in the mechanical industries is by keeping informed of the progress and developments recorded in the technical press. Engineering conventions and meetings also offer a valuable, although less systematic, method. But the service rendered by the mechanical publications is constant, and, obviously, the range of subjects covered is wider and the type of information broader than can be obtained in any other way.

A survey of the opinions of several thousand chief mechanical executives throughout the United States showed that the New Shop Equipment and the Materials Sections in MACHINERY, covering as they do, from month to month, every new development in the field, are considered among the most important sources of information for the mechanical executive; nor do these men overlook the information available in MACHINERY on shop processes and methods, mechanisms, design, etc. These men, responsible for results in their respective industries, have the wings of imagination—otherwise they would never have come to occupy places of industrial leadership—but they also have their feet on the solid ground of technical information.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Adjustable Strip Feeding Device

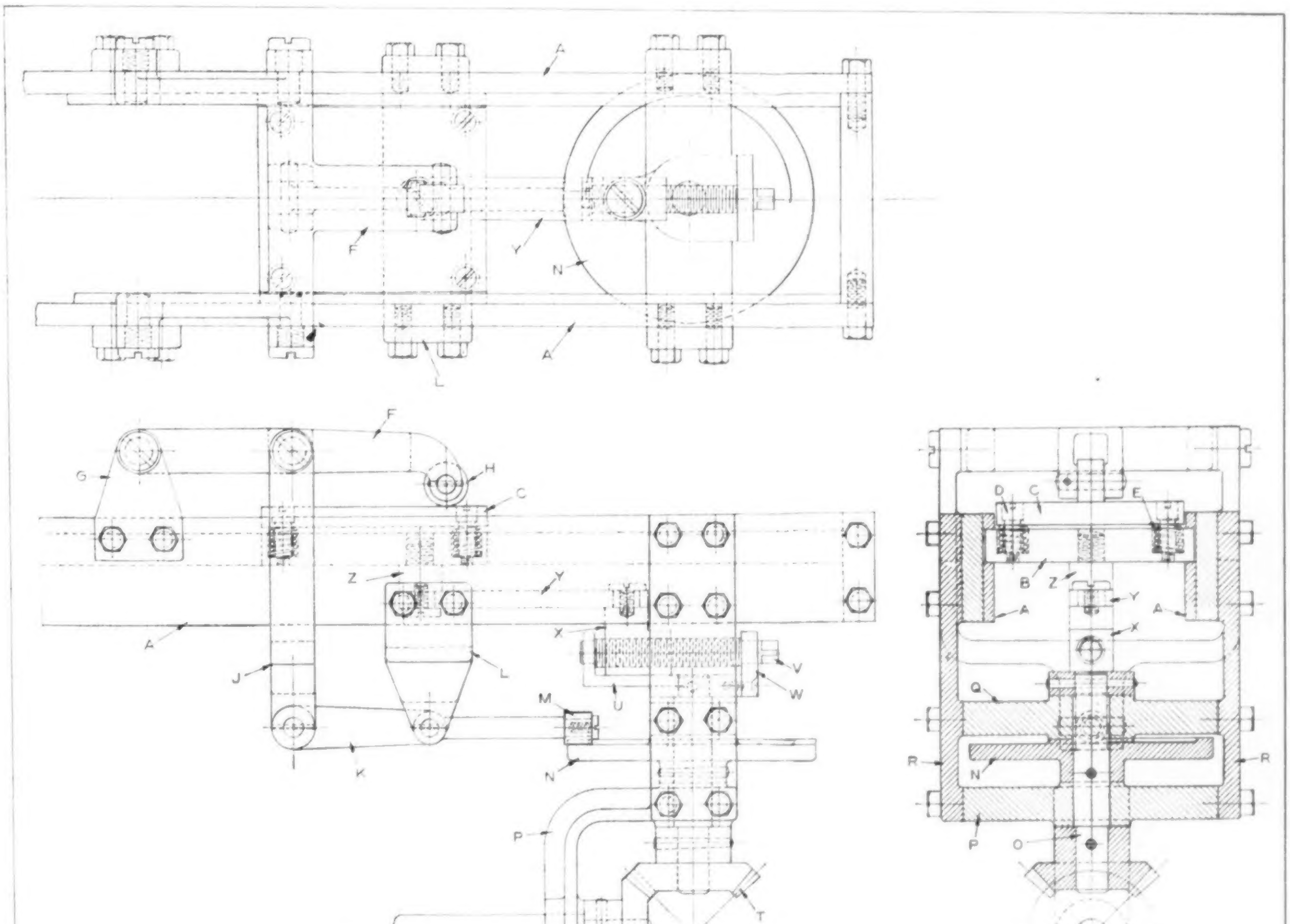
By VINCENT WAITKUS

In feeding strip material, it is frequently desirable to vary the feeding stroke or adjust it accurately to meet changing conditions. The device described here can be adapted for feeding strip material of any form or type and permits adjustment of the feeding interval or stroke to a minute degree by means of an adjusting screw. It is very efficient when moderate feeding rates are used.

The operation of the device is as follows: The plate cam *N* is provided with a ridge around 180 degrees of the circumference which serves to raise the end of cam-lever *K* on which roll *M* is mounted. The oscillations thereby created by the cam in lever *K* are transmitted to the pressure lever *F* through the link *J*. Thus lever *F* serves to depress and release the upper plate *C* which grips the stock at definite intervals, as determined by the position of cam *N* under the cam roller *M*.

The lower sliding plate *B* and the upper plate *C*, which form a unit through the connection of the screws *D*, are actuated by the eccentric block *X* through the connecting link *Y*. The continual rotation of block *X* causes the entire strip-gripping arrangement under roller *H* to reciprocate.

By combining the clamping motion created by cam *N* and the feeding movement imparted by the



Strip Stock Feeding Mechanism with Means for Adjusting Stroke

block X, the strip material is gripped in the jaws of the gripping assembly and given the required feeding movement. The smooth and regular operation of the device is assured by synchronizing the rotation of eccentric X with the rotation of cam N in such a manner that the gripping device will be released slightly before it has reached the end of its stroke. This will avoid the possibility of dragging the strip back slightly on the return stroke of the gripping assembly.

Strip material of any kind can be handled by the feeding device. Flat surfaces in the gripping assembly would serve well for materials that are slightly compressible. For hard materials, it may be necessary to roughen the surfaces in order to obtain a firmer hold. By altering the shape of the surfaces, it would be possible to handle materials of a form other than flat. For instance, wire can be easily controlled in a device of this type.

Referring to the construction of the device, the rails A are a part of the machine structure, and, in addition to serving as a support for the device, they have channels which guide the lower sliding plate B. The upper plate C is held in place by four fillister-head screws D, the heads serving as pilots for the upper plate. Four springs E around screws D tend to keep the upper and lower sliding plates apart. The whole assembly constitutes the strip-gripping arrangement.

The pressure lever F is supported in brackets G fastened to the rails A so that roller H rests on the surface of plate C. Link J serves to connect lever F with the cam-lever K. The cam-lever is supported in the bracket L, also fastened to the rails A, and is provided with the cam roller M which makes contact with cam N.

Cam N is fastened to the shaft O which is supported between the bearings P and Q. The bearings are fastened to the support bars R which, in turn, are attached to the rails A. The necessary power for actuating the device is obtained from the shaft S through the bevel gears T.

The stroke-adjusting arrangement consists of a screw-carrier U fastened to shaft O, the adjusting screw V, the end plate W fastened to the screw-carrier and serving to retain the adjusting screw in place, and the eccentric block X. Turning screw V causes eccentric block X to travel closer or farther away from the center of shaft O, thereby decreasing or increasing the eccentricity. The link Y serves as a connection between block X and the strip-gripping assembly through the extension block Z.

Variable-Stroke Mechanism for Toggle Lever Press

By PAUL GRODZINSKI

Toggle lever presses and eccentric presses of the usual type have no provision for adjusting the stroke, and only by adjusting the length of the connecting-rod can the position of the ram at the end of the stroke be changed. With the new mechanism shown in Fig. 1, however, it is possible to make any desired adjustment of the stroke length while the press is running.

The ram I is actuated in the usual manner by a connecting-rod H attached to lever G. The length of lever H can be varied by means of a screw, so that the ram can be located at any desired position at the end of the stroke. Between the free end of lever G and the swinging lever D which has a fixed bearing in the press body, there is a short member F and a longer member C. To obtain a positive movement, point J on member C is compelled by member E to follow a circular path.

A rotating crank A drives member C by means of a connecting-rod B. The stroke adjustment is accomplished by means of the lever E. Lever E has the form of a quarter sector provided with holes that correspond with other holes in the press body. By changing the bolt K on which lever E swings to one of the other holes in the press body, the length L of the ram stroke will be changed. The position of the ram at the end of the stroke, however, remains the same.

The members D, C, and F being located in nearly the same vertical plane, as shown in the illustration, then exert the maximum pressure on the ram. In the actual design, sector E is replaced by a worm-wheel which permits regulating the position of bolt K on which lever E is pivoted. With this arrangement, the bearing or bolt K can be moved on a circle around the center of the worm-wheel which coincides with point J.

The three views in Fig. 2 show the mechanism

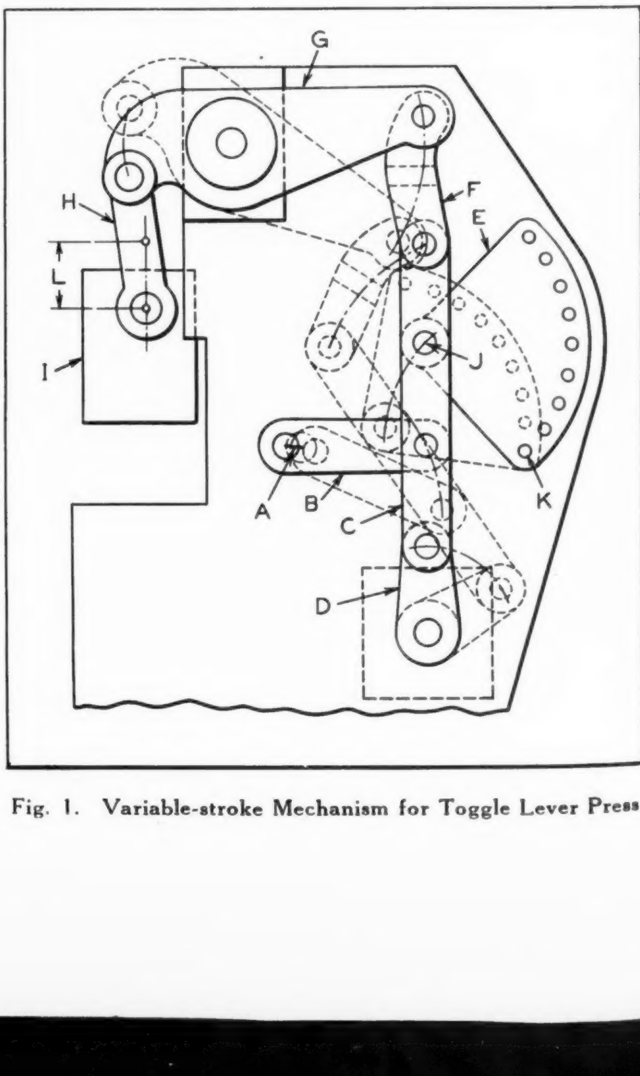


Fig. 1. Variable-stroke Mechanism for Toggle Lever Press

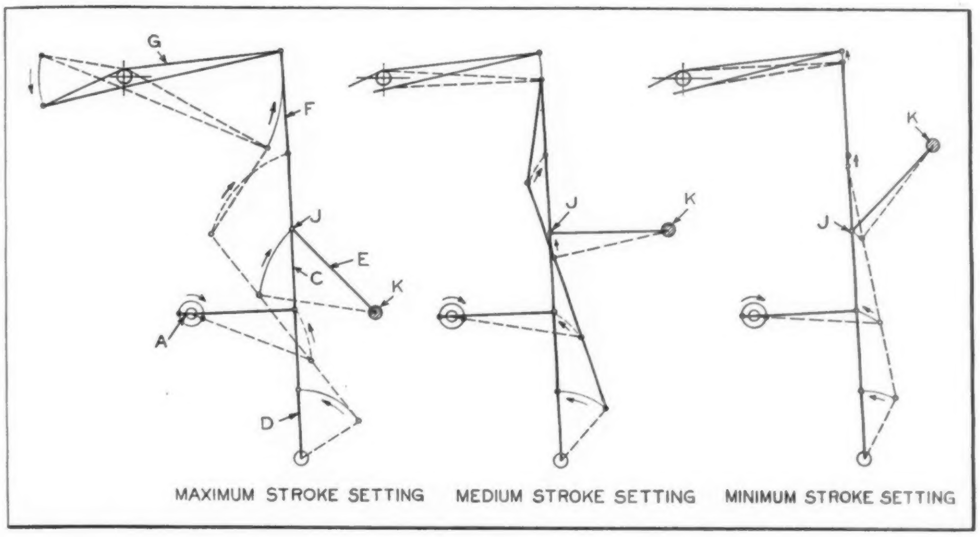


Fig. 2. Method of Adjusting Mechanism Shown in Fig. 1 for Different Length Strokes

with the bolt *K* of member *E* located in three positions which give the maximum, medium, and minimum strokes. Precise adjustment of the stroke can be made before the press is started or while it is running. The crank *A* rotates through a complete circle. With clockwise rotation, the arc for the downward stroke is larger than for the return stroke; this results in the downward speed being somewhat reduced. Reducing the length of the stroke, in turn, reduces the time required for the downward movement.

Presses with the variable-stroke arrangement described are built in capacities of from 5 to 120 tons and with maximum strokes of 6 to 12 inches by Gustav Hellmann, Sundwig, Iserlohn, Germany.

Ratchet Movement with Idle Period

By L. KASPER

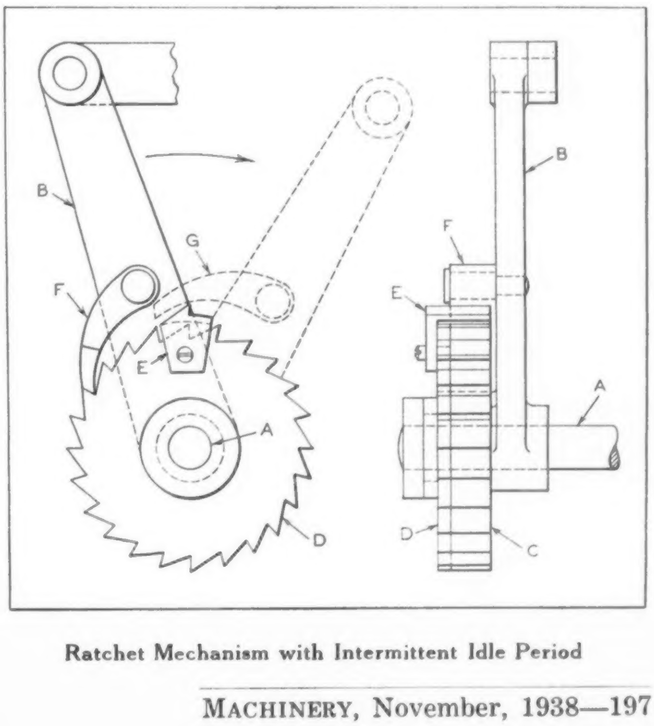
A ratchet movement operated by an oscillating lever in the conventional manner, except that the pawl is rendered inactive at a predetermined period, is shown in the accompanying illustration. This movement is used to operate a conveyor belt on a wire-forming machine, the purpose of the idle period being to increase the loading time at a certain point in the cycle.

Lever *B* is free to oscillate on shaft *A*. Ratchet wheel *C* is keyed to shaft *A* and carries on its hub a similar but narrower ratchet wheel *D*. The latter wheel is free to turn on the hub of wheel *C*. Pawl *F*, which transmits the motion of lever *B* to ratchet wheel *C*, is sufficiently wide on the working end to engage both ratchet wheels *C* and *D*. Ratchet wheel *D* carries the single-toothed dog *E*.

In operation, ratchet wheels *C* and *D* are given a partial revolution through the engagement of pawl *F* with their teeth, as the lever *B* swings to the left. On the return stroke, lever *B* swings to the right and pawl *F* rides over the teeth of the ratchet wheels, which remain stationary. The illustration shows lever *B* at the end of its forward stroke and about to swing to the right in the direction indicated by the arrow.

Toward the end of the return stroke of lever *B*, pawl *F* is lifted out of contact with the ratchet teeth by dog *E*, as indicated by the dotted lines at *G*. As lever *B* reaches the end of its return stroke, pawl *F* drops behind the tooth of dog *E*, but is still held out of contact with the ratchet. Then when lever *B* swings to the left, pawl *F* engages the tooth of dog *E*, giving the ratchet wheel *D* a partial revolution. As there is no connection between ratchet wheels *C* and *D*, wheel *C* remains stationary during this part of the cycle. On the succeeding forward strokes of lever *B*, pawl *F* again actuates the ratchet wheels *C* and *D* until dog *E* is once more brought under pawl *F*.

The movement, as shown, is designed to provide one idle period in six motions of lever *B*. Other cycles may be provided for by using more than one dog, but it is necessary that the angular movement of lever *B* be evenly divisible into the 360 degrees of a circle; otherwise it will not be possible to maintain a definite timing cycle. The rest period can be eliminated at will by merely setting ratchet wheel *D* so that pawl *F* will pass over dog *E* on the return stroke of lever *B*, thus allowing pawl *F* to engage the ratchet teeth at all times.



Ratchet Mechanism with Intermittent Idle Period

Stack-Cutting—A Newly Developed

Both Simple and Intricate Shapes Are Readily Produced in Large Quantities by Oxy-Acetylene Machine-Cutting of Plates Stacked in Piles—Last of Two Articles

By D. E. ROBERTS, Engineer
The Linde Air Products Company
New York City

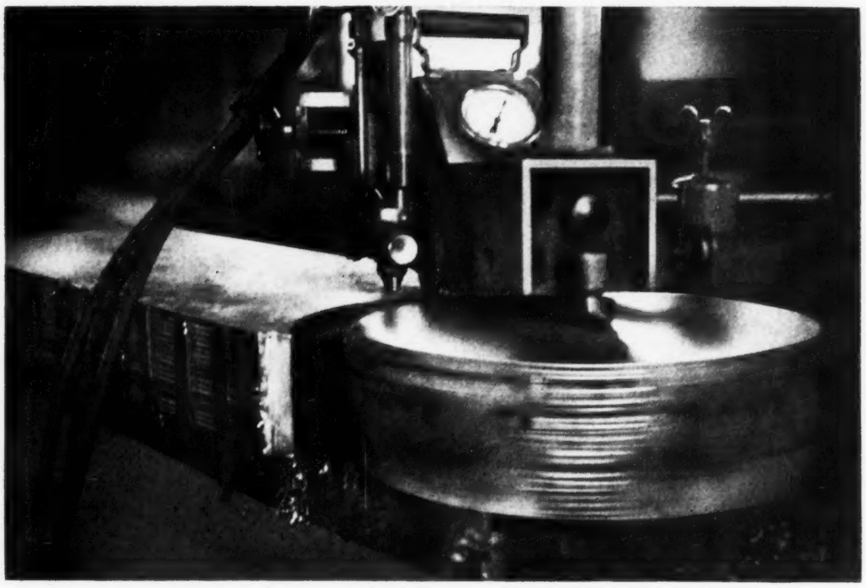


Fig. 7. Stack-cutting Twenty Small Circular Plates with a Portable Cutting Machine, Using Welding Beads to Replace Other Clamping Means

THE first installment of this article was published in October MACHINERY, page 65. It dealt with the general application of the process of stack-cutting and covered several applications, including those in the heavy industries. The present installment will deal with the stack-cutting of circular disks and of small intricate shapes. It will also refer to the trimming of plates by stack-cutting methods.

In addition to the fabrication of large and heavy flame-cut steel parts for large-scale production or repair work, stack-cutting is now extensively used for cutting circular disks in plate varying from 1/16 to 1/2 inch in thickness, used largely for cylindrical tank ends. Stack-cutting provides one of the most economical methods of cutting such parts, and one that can easily and quickly be adapted to different sizes of disks from various thicknesses of plate. Cutting can be performed by means of stationary oxy-acetylene cutting machines or by small portable machines.

In stack-cutting disks or "circles," as they are frequently called, the set-up and clamping method used depend, of course, on the diameter of the circle being cut and on the thickness of the plate. For the stack-cutting of thin plate, say from 1/16 to 3/16 inch, with a stationary machine, C-clamps alone may be used with perfect satisfaction. When a portable machine is used, a large permanent clamping device is necessary, as provision must be made to allow the machine to circle beneath the clamp. On smaller jobs, where the construction of such a clamp is not justified, small circles can be stack-cut with a small portable machine by using welding beads along the edges of the plate to eliminate the necessity of clamping.

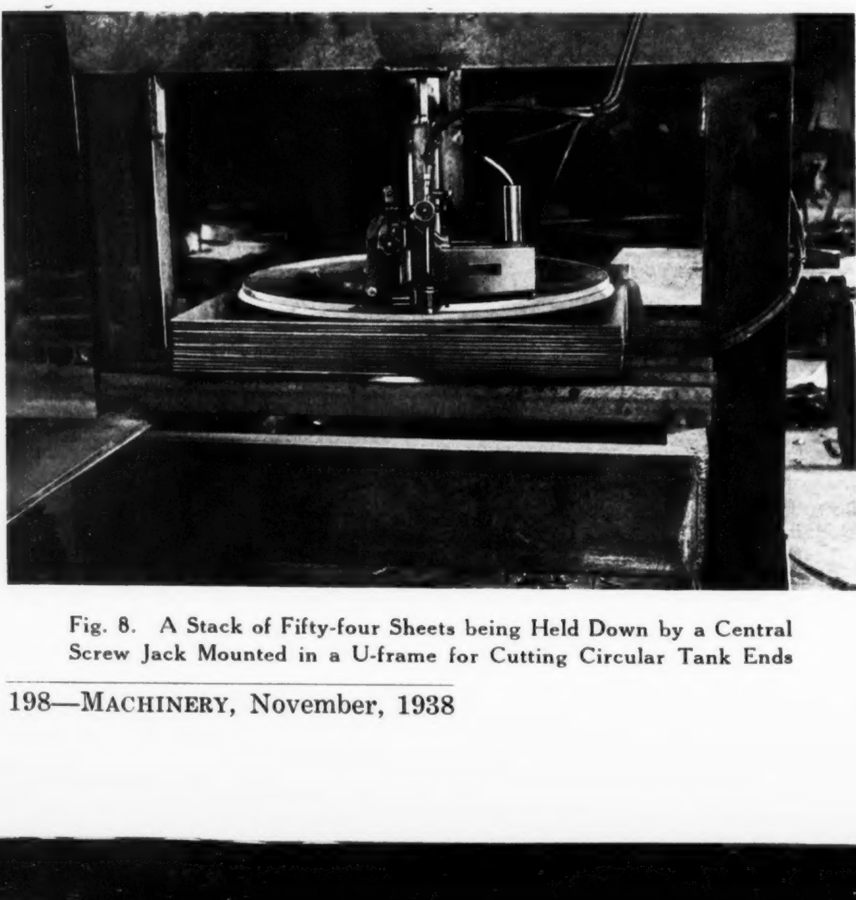


Fig. 8. A Stack of Fifty-four Sheets being Held Down by a Central Screw Jack Mounted in a U-frame for Cutting Circular Tank Ends

The job illustrated in Fig. 7 consisted of cutting one hundred 13 3/4-inch diameter tank ends from 3/16-inch plate. Twenty plates were stacked together, making a stack approximately 4 inches thick, and several welding beads were run up the sides of the stack while the plates were

Flame-Cutting Process

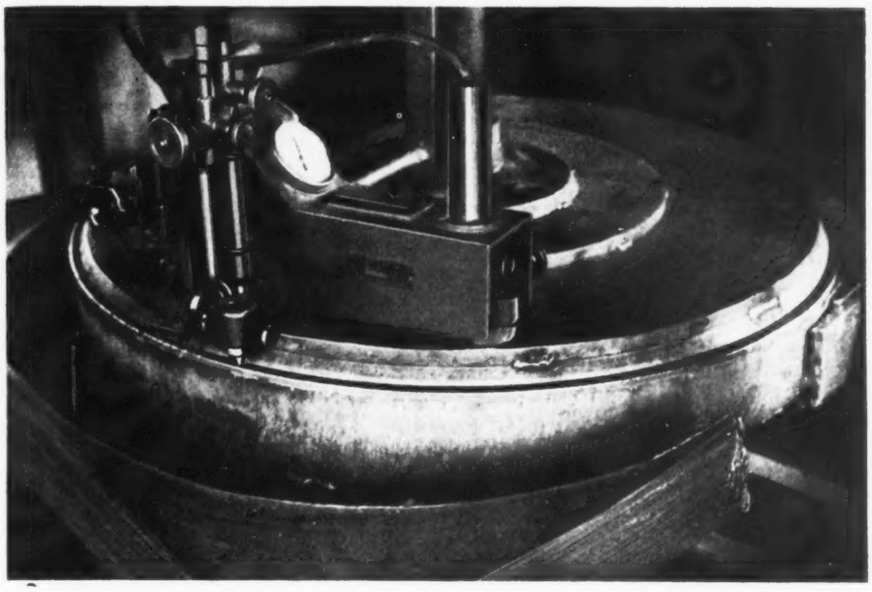


Fig. 9. A 1 1/2-inch Thick Clamping Plate Applies Pressure Evenly to the Stack while the Cutting Machine is Guided by a Radius-rod

held in a press. Since the plates that were stacked together were extra long, it was necessary to put a heavy bar clamp across the center to keep them from buckling. These heavy bars were held together with C-clamps at both sides of the long plate. The cutting consumed about 43 cubic feet of oxygen per stack, proceeding at about 6 inches per minute. The quality of the cuts was good, as can be observed in the illustration.

Circles of large diameter can be stack-cut on a production basis with a small portable cutting machine, as illustrated in Figs. 8 and 9. The job consists of cutting 39-inch diameter circles in 14-gage plate, fifty-four at a time, the stack being approximately 4 inches thick. The means used to clamp the plates consists of a heavy U-frame with a central screw jack. The jack works on a cover or clamping plate, which is first cut out approximately 1 inch less in diameter than the circles being cut. The cutting machine is automatically guided by a radius-rod, which is fastened to the central screw jack by a movable collar and can be adjusted for cutting various diameters. The cutting of these fifty-four circles required 90 cubic feet of oxygen and an actual cutting time of about 15 minutes. The company performing this operation estimated that this method of cutting circles resulted in a 50 per cent saving, as against cutting in a circular shear.

Stack-cutting of small intricate shapes is readily accomplished by means of a cutting machine which can be made to follow a templet design automatically. The choice of clamping device will depend on the nature of the work to be done and the facilities available. For small pieces, toggle clamps are probably the most convenient, although the method of running welding beads up the side of the stack is very satisfactory.

A typical application of stack-cutting to the fabrication of small intricate shapes is illustrated in Figs. 10 and 11. A part called a German knife, used for cutting cloth in the manufacture of linoleum, was shape-cut by stack-cutting strips of 3/16-inch boiler plate, 11 inches wide and about 8 1/2 feet long. Six plates were cut at one time with an oxygen consumption of from 40 to 45 cubic feet per stack. The actual cutting time per stack varied from 9 to 12 minutes, which included making two starts, one for the octagon-shaped hole in the center of the knife, and the other for the outside profile.

It has been found economical to use the stack-cutting process for trimming the edges of large plates to size after they have been drilled or punched for riveting. Large plates, approximately

Fig. 10. Stack from which Two Sets of Linoleum-cutting Knives have been Flame-cut, Six at a Time, from 3/16-inch Boiler Plate

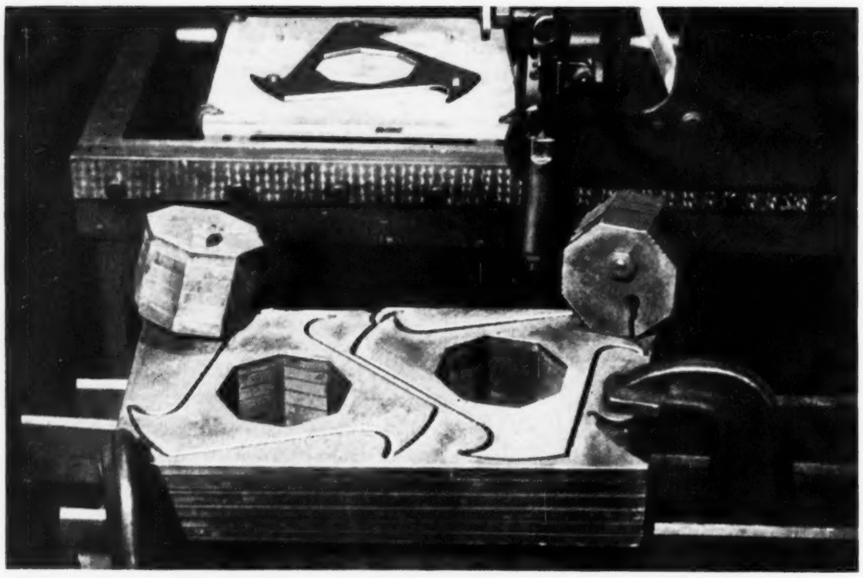


Fig. 11. Close-up View, Showing Templet and Stack of 3/16-inch Steel Plates with Two Cloth-cutting Knives Completely Cut Out

10 by 30 feet, requiring rivet holes around the outer edge are fabricated in the following manner: First the holes are carefully laid out on one plate and drilled or punched. Then this plate is laid on top of some six or ten plates. The whole stack is next clamped together and drilled, using the top plate as a templet. Four corner holes are usually drilled first, and bolts are placed through these holes to hold the stack firmly in position. After all the holes have been drilled, additional bolts are placed through these holes. Finally, a small portable oxy-acetylene cutting machine is used to trim up the edges of the plates to the exact size.

This method has proved to be more economical than trimming the plates to size individually on a shear, as it eliminates considerable labor and handling time, and produces plates of identical size.

Stack-Cutting Economies

In considering the economies possible with stack-cutting, it is well to keep in mind that the savings in production expense may depend upon properly calculated work schedules, as much as upon the correct operation of the cutting machine itself. To obtain lower costs, a continuous supply of sheet material must be brought to the machine, and provision must be made for quickly removing the finished work and sending it on to the next processing operation. A machine can yield the maximum economies only if it is kept operating at full capacity. Maintaining the machine at full capacity is greatly facilitated by organizing the work so that loading and unloading of the plates can be performed progressively as the cutting operation goes on.

A particularly advantageous feature of stack-cutting is the large saving which is obtained from the recovery of new, usable material. With shearing and coping methods, most of the scrap metal is removed from the sheets in pieces that are not large enough to be used in the manufacture of smaller metal products. With the oxy-acetylene cutting process, however, the metal removed is in large pieces which can often be utilized in the manufacture of other parts. Frequently, by proper designing, the scrap can be used without further fabrication (Fig. 12). In one fabricating shop, usable scrap material to the value of nearly $200 is being recovered during a six-day period.

In conclusion, it may be of interest to note the quality of products made by oxy-acetylene machine-cutting. When the sheets are cut in stacks by the cutting machine, every piece is identical in contour, and this contour can be duplicated over and over. The edges of the oxy-acetylene cut sheets are square and full, with no burrs or slivers. This advantage is of special importance on circles that are subsequently to be flanged or dished. There is a total absence of tearing when the oxy-acetylene stack-cut sheets are formed, owing to the fact that the cutting operation does not leave any sharp corners which have high stress concentrations, and which in subsequent operations yield under the additional bending stress of the press dies. The radii left at such locations in the sheet contour tend to strengthen this section, and provide additional material for the drawing action of the die.

* * *

Gasoline taxes in the United States rose from approximately $1,000,000 during 1919 to almost $1,000,000,000, or one thousand times as much, in 1937. The gasoline taxes collected last year averaged close to $33 for every automobile and truck in use in this country.

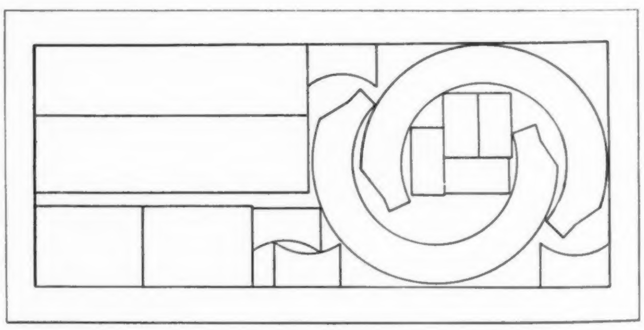
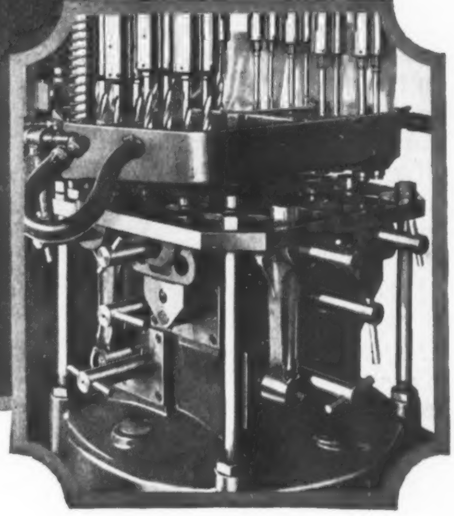


Fig. 12. Diagram Showing How Completely Plates Can be Utilized with a Minimum of Scrap. In the Example Shown, Two Sets of 3/16-inch Thick Parts are Cut Twelve at a Time from Sheets 36 by 84 Inches in Size

Design of Tools and Fixtures



Form-Cutting Attachment for Slotting Machine

By J. R. WHITTLES, Holden, Mass.

The slotting machine attachment shown in Fig. 1 was designed for profiling or shaping the work *W* to the outline indicated by the dot-and-dash line *A*, Fig. 2. Although designed and used successfully for cutting the particular profile indicated, any other desired shape within the range of the attachment can be machined by replacing the guiding cam *C* with one having the required shape or contour.

Referring to Fig. 1, the body *B* of the fixture is attached to the head end of the slotting machine ram, the upper portion of the body (not shown in the illustration) being designed to use the regular fastening bolts. The machine ram reciprocates the head on which the cutter or tool *T* is mounted. At the same time, the head is rotated and also fed in or out radially as determined by the shape of the cam *C*. The combination of the rotating and in-and-out movements of the reciprocating tool results in machining the work to the shape required.

The clapper *D* which holds the tool pivots in the clapper-box *E*. The clapper is normally held in the cutting position by a spring *F*. The clapper-box *E* is attached to the rotating head or ring *G* by means of a dovetail slide that permits a radial sliding

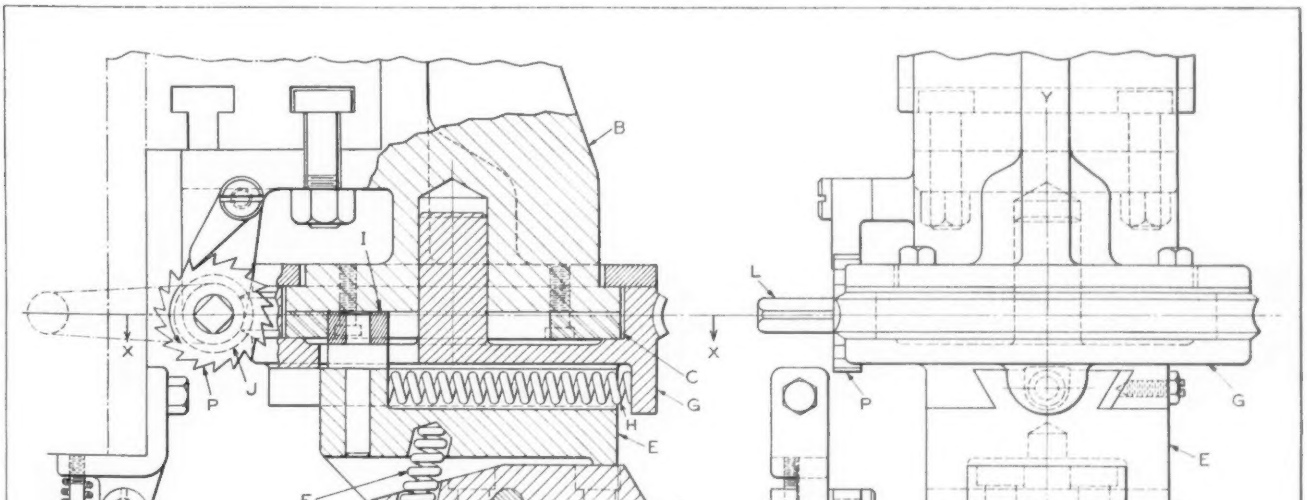


Fig. 1. Attachment Used on Slotting Machine for Forming Profile Indicated by Dot-and-dash Line A, Fig. 2

movement which is controlled by the cam *C*. A roll *I*, mounted on a pin in the clapper-box *E*, is kept in contact with the cam *C* by a compression spring *H*.

A worm *J* engages the worm-wheel teeth *K* cut in the ring *G*. The worm *J* has a squared end at *L* for the handle employed in rotating the ring *G* by hand to bring the tool into the cutting position. The tool is adjusted radially for depth of cut by means of a set-screw *M*, after which it is clamped in place by tightening the nuts *N*. A rotary mechanical feed is transmitted to the tool through rotation of the worm *J* by the ratchet wheel *P* and the latch *R*, which is adjusted to come in contact with one of the teeth on the ratchet wheel *P* on the upward

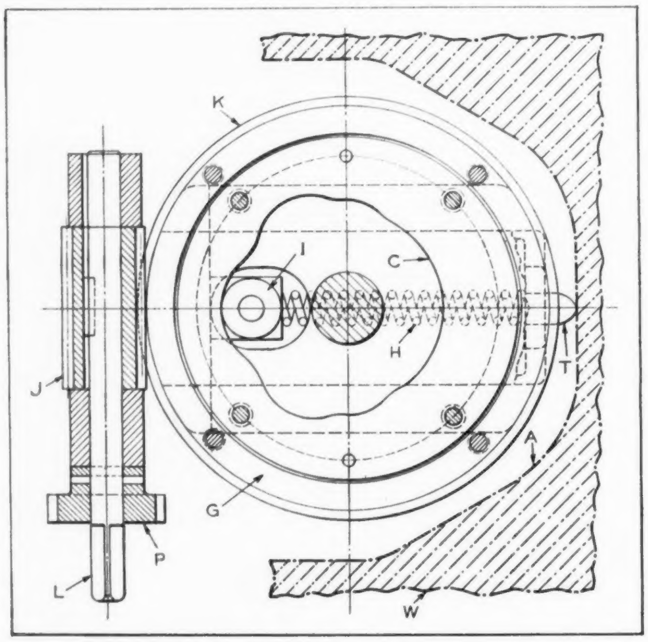


Fig. 2. Section X-X, Fig. 1, and the Profile A Machined by Tool T Guided by Cam C

stroke of the ram. With this arrangement, the point of the tool *T* will follow the contour of the outline indicated by the dot-and-dash line *A*, Fig. 2.

Dies for Drawing an Oval Lamp Shade

By M. J. GOLDSTEIN, New York City

The formed shell shown at *C*, Fig. 1, is of a type that usually gives the diemaker considerable trouble, due to the drawing action which takes place mainly at the small ends of the shell, while no drawing strain is imposed on the central part. If sufficient pressure is applied to the blank to keep the center from wrinkling, the pressure will be too great for the ends of the shell, and rupturing of the metal will occur.

Shells of this type can be made successfully in a drawing press only when uniform pressure is applied during the drawing operation. The blank for this shell, shown at *A*, Fig. 1, is 20-gage (0.032

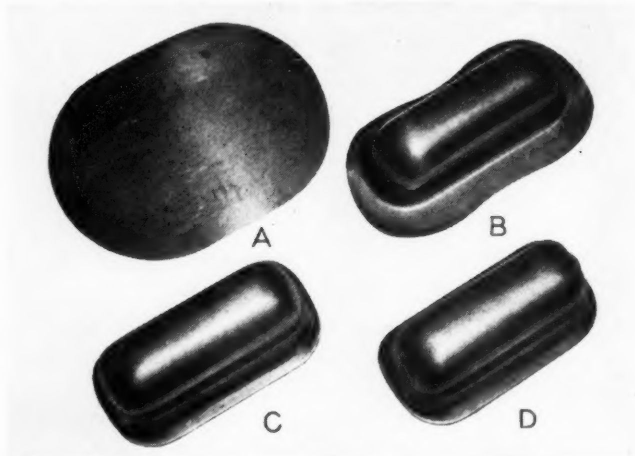


Fig. 1. (A) Blank; (B) Formed Shell; (C) Trimmed Shell; (D) Completed Lamp Shade with Ends Raised, Flattened, and Pierced

inch thick) sheet metal, both brass and steel material being used. Deep drawing material is required in both metals. The oval blank is 8 1/2 by 11 inches.

The die for the first operation is shown in Fig. 2. Both the die and the blank-holder are cast iron, the die, however, having a tool-steel face. The drawing edge has a radius of 9/16 inch. As there is more metal in one side of the shell than in the other, the opening in the die and blank-holder is set off center 1 inch. To further equalize the difference in pressure required for the ends and center of the shell, the top surface of the die is ground to the shape indicated by the dot-and-dash lines *X-X*, Fig. 2, so that the ends of the die are 0.008 inch lower than the center. This prevents breakage at the ends of the shells.

The punch for the first operation is made of cast iron and has a standard 1 3/8–8 threaded hole, by means of which it is attached to the press ram. An air vent hole leads to the outer air. The shell is drawn to a depth of 2 1/2 inches in this die, which may be considered a good draw, especially as the width of the shell is 2 3/4 inches.

The second operation, in which the shell is finish-

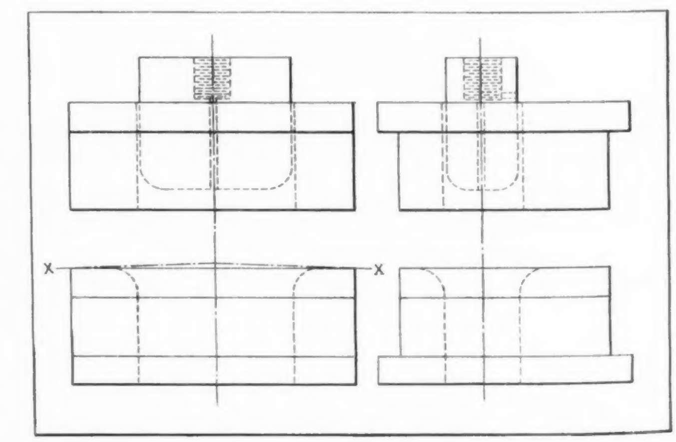


Fig. 2. Die for First Forming Operation on Shell

formed, is performed by the die shown in Fig. 3. The construction of this die is similar to that of the die used for the first operation. The drawing edges on three sides of the die opening have a radius of 3/8 inch, which blends into a radius of 1 1/8 inches on the fourth side, or front of the shell. This shell, when finished, forms an adjustable shade for a desk lamp.

The shell is next trimmed in an ordinary trimming die. The punch of this die has attached to its face a cast-iron pilot which is the same shape as the inside of the shell. This pilot serves to locate the shell properly before the trimming operation begins. The shell is placed on the die, open end up, and when trimmed, drops into a box below the press. The trimmed shell is shown at *C*, Fig. 1.

The shell is required to have two flat surfaces at each end, in the center of which are pierced holes for supporting trunnions on which the shade can be swiveled. The size of the shell did not permit this part of the work to be done in an ordinary press. As several horn type presses with adjustable tables were available, the die for this work was designed for use in a press of the latter type.

The die for the horn press was made with interchangeable parts both to raise the flat surface and to perforate the hole at each end of the shell. This die is shown in Fig. 4 arranged to draw the flat surface. The die used for the latter operation is of unusual design in that both the pressure pad and the spring for exerting pressure are contained within the area covered by the shell when in the flattening and piercing positions. It was first attempted to perform this work without employing any pressure to hold the metal in place, but this produced wrinkles in the shell. When the spring pressure arrangement was added, however, a smooth shell was produced.

After this drawing operation the perforating die is substituted for the drawing die, and the shells, after perforating, are ready for the finishing and assembling operations.

Applications of grease to the ends of the steel blanks enable them to slip more easily between the pressure surfaces and prevent breakage. No. 2 Albany grease was used for this purpose, but practically any similar grease can be employed. The heavy body of the grease acts as a cushion on the parts of the blank to which it is applied. Only a thin film of grease is required. The grease is used only on the steel blanks, as no trouble is experienced in drawing the brass shells without a lubricant.

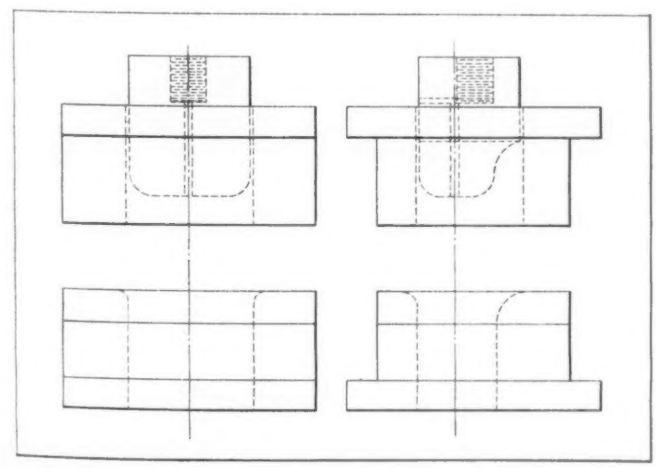


Fig. 3. Die for Second Forming Operation on Shell

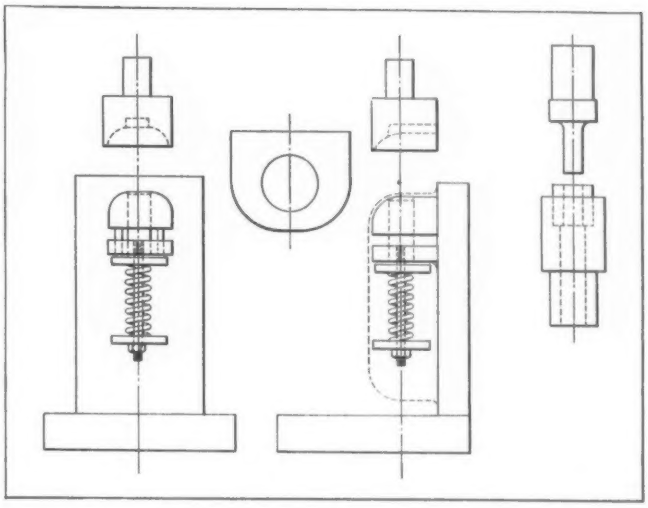


Fig. 4. Die Equipment Used on Horn Type Press for Flattening and Piercing Operations

* * *

How Long Can Industry and Labor Stand Losses Like These?

The Briggs body plant in Detroit installed a new conveyor system for the 1939 model bodies. The automobile workers' union complained that it was operated at an excessive speed. The management contended that the schedules were not speeded up beyond those of last year. In the dispute, it appears that two union workers were dismissed for insubordination, and thereupon 9000 workers staged a brief sit-down strike and then walked out.

As a result, the Plymouth factory in Detroit, with its supply of bodies cut off, was forced to close and 7000 men in that plant lost their earnings. Some 2000 more workers became idle in one of the Canadian Chrysler plants. By the middle of September 18,700 workers were idle and 30,000 more jobs were in jeopardy. Furthermore, 12,600 dealers will be kept waiting for new models that had been promised to customers.

And this is not the whole picture. When the automobile factories cannot get bodies, they do not need steering wheels, ignition systems, tires, windshields, and dozens of other accessories. Tens of thousands of workers in the plants making these parts also become idle unless disputes such as that mentioned are quickly settled—and all because of only two men, the justice of whose case could quickly have been determined by an impartial arbitrator.

How long can this nation afford to hobble along with an industrial and labor system under which the alleged speed of one conveyor belt can deprive tens of thousands of people of their earnings?

Making Links from Ribbon Stock at the Rate of 340 per Minute

A Multi-Slide Machine with Unique Tool Equipment is Employed for the Rapid Production of Formed Links from Ribbon Stock

THE production of small parts from ribbon or wire stock on Multi-slide machines is generally recognized as one of the most economical methods of manufacturing a great variety of small products. Such operations as piercing, forming, bending, trimming, and shaving can be performed in rapid succession when this method is employed. An interesting application of the Multi-slide machine built by the U. S. Tool Co., Ampere, N. J., has been made recently by an electric refrigerator manufacturer in the production of the ice-cube separator link shown in the enlarged-scale view at *A*, Fig. 3.

Stock having a width slightly greater than the combined widths of four of these finished parts is mounted on a reel, as shown at *B*, Fig. 1. From the reel the stock is carried forward by the feeding block *C*, Figs. 1 and 3, through the two-way straightening unit at *D*. It then enters the die *E*, where it is trimmed on one edge and slit into four strips 0.312 inch wide.

On the following feeding strokes, the four strips are brought to the cut-off and shave die *F*, Fig. 3, where the punch *G* slots the end of all four strips, as indicated at *H*. The cut-off punch *G* is operated by the front slide. The die *F*, part of which is shown at *I*, is mounted in a fixed position and is located on the upper level in line with the trimming die.

The next feeding stroke carries the stock forward into the cutting-off position, with the slotted ends *H* in position to be shaved by die *I* and the shearing end *S* of punch *G*. When punch *G* is advanced, it cuts off the four strips, blanking their ends to the tongue shape indicated at *J*, Figs. 1 and 3, and shaving the slots at the opposite ends to a width of 0.133 inch within the limits of accuracy indicated in Fig. 1.

Continued forward movement of punch *G* carries the four blanks past dies *F* and *I* to the position indicated at *K* in the vertical transfer mechanism. When punch *G* is partially withdrawn, the four parts at *K* are transferred by the vertical slide *L* to the lower level position in front of the forming post *M*. Tools *N*, *O*, and *P* on the front, right, and left sides of the lower level, are arranged to completely form the four pieces on the post *M*, as shown at *Q*. The four finished pieces are ejected when four new blanks are transferred to the lower level on the following stroke.

The vertical transfer operation is really accomplished in two planes. The straight blanks are car-

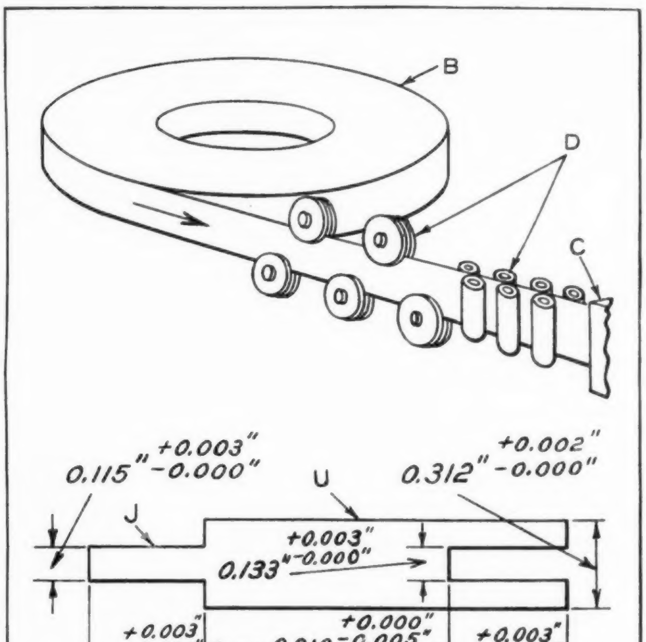
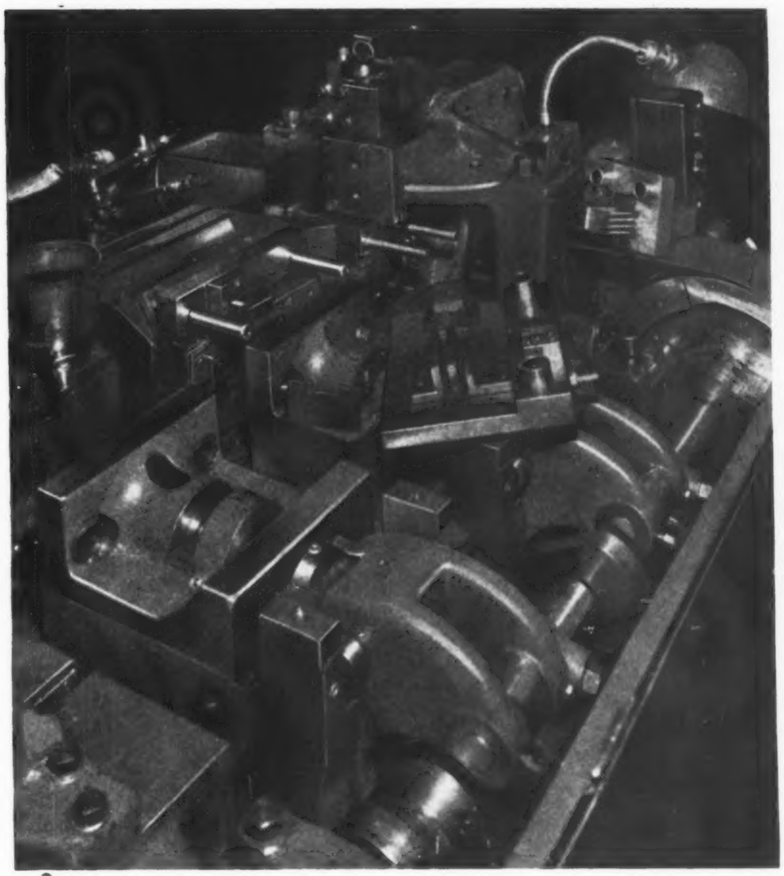


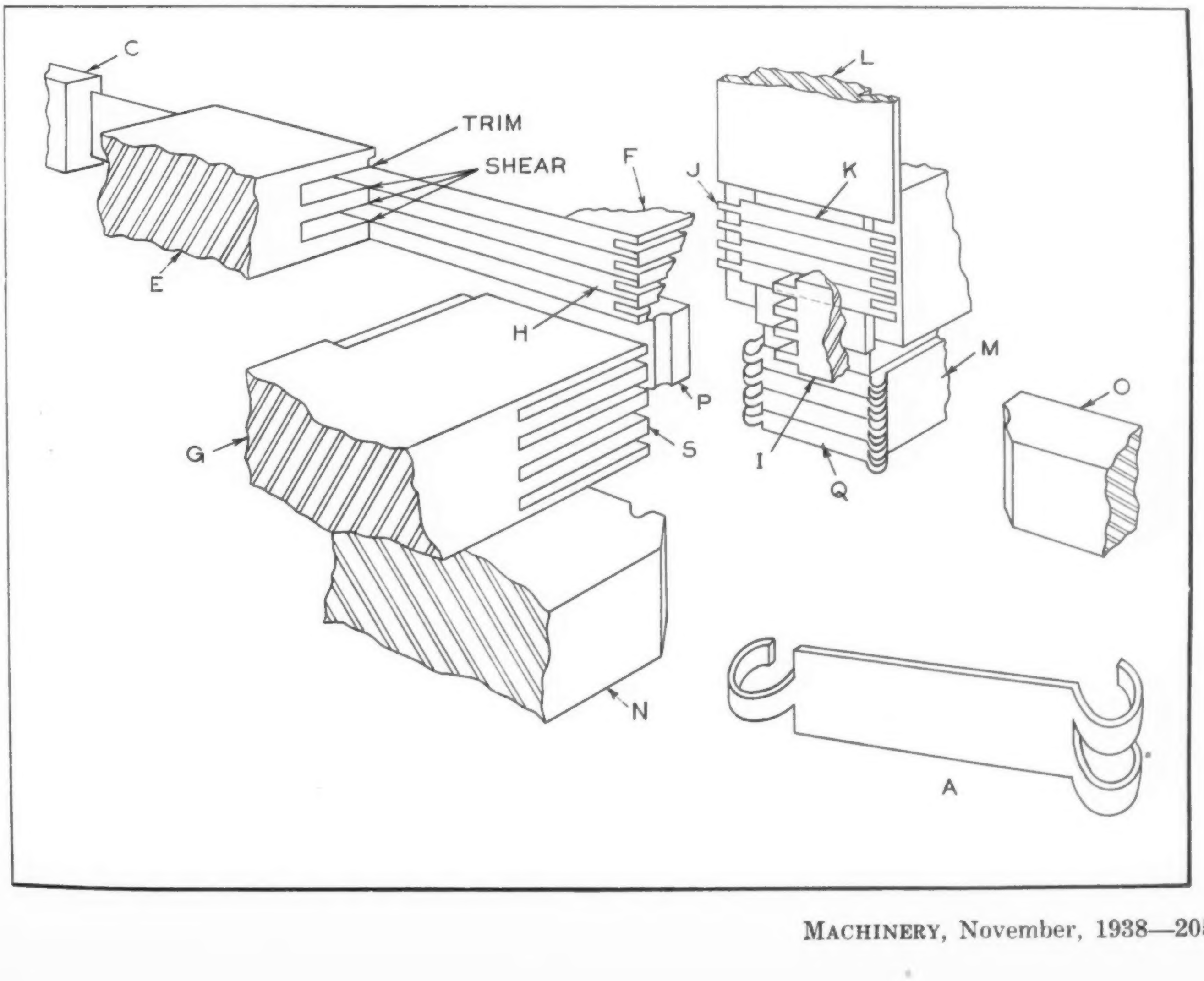
Fig. 1. Ribbon Stock Reel B and Two-way Straightening Unit D Used on Multi-slide Machine in the Production of the Link W. Also Shown at A, Fig. 3

Fig. 2. (Right) Close-up View of Tool Equipment of Multi-slide Machine which Produces Link A, Fig. 3, at the Rate of 340 per Minute

Fig. 3. (Below) Diagrammatic View, Showing Upper and Lower Level Arrangement of Tool Equipment Used in the Production of Link A



ried to the lower level in a plane located by the front face of the forming portion of post *M*. After forming, however, the straight portion of the formed piece is in a plane slightly to the rear of the plane in which it is fed to the lower level. The vertical transfer mechanism is arranged to eject the finished parts by contact with this straight portion of the finished part. In this manner, the finished parts are ejected before the straight blanks are brought to the forming position. There is no possibility of interference, as the blanks are brought into position by a step in the stripper blade and the finished parts are ejected by the lower face of the same blade.



Carburizing—an Old Process

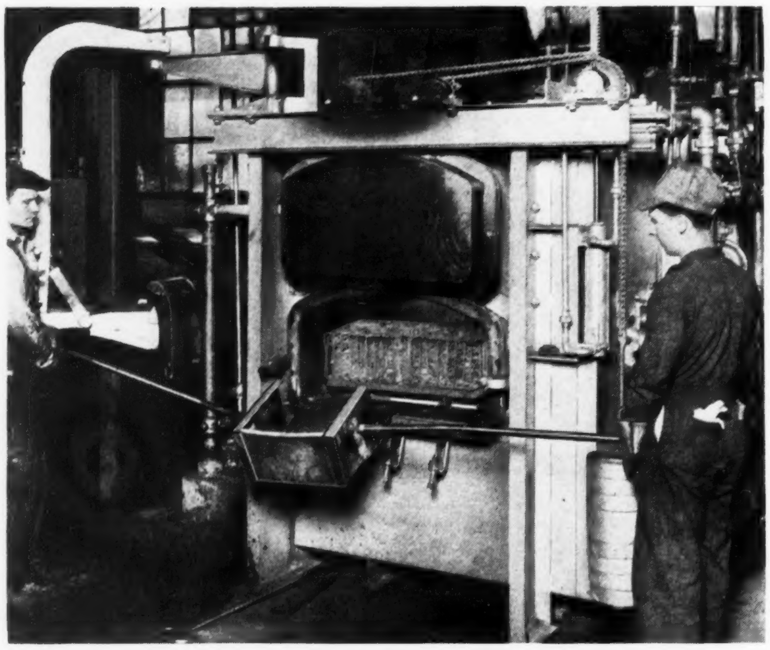


Fig. 6. Operators Removing Work from a Batch Type Eutectrol Carburizing Furnace

New Developments that have been the Cause of Recent Great Improvements in Carburizing Methods—Second of Two Articles

By F. D. WIDNER
Research Engineer
Surface Combustion Corporation
Toledo, Ohio

IN the first installment of this article, published in October MACHINERY, page 98, the methods formerly used for carburizing were reviewed and new types of gas carburizing furnaces were described. The present article will continue the description of gas carburizers, dealing specifically with the horizontal muffle furnace of the batch type.

There are instances where production conditions do not warrant the installation of a large continuous type furnace, especially where the quantities of work are varied and production not continuous. For this purpose, a horizontal muffle furnace of the batch type, illustrated in Fig. 6, has been developed. Here, the work is loaded on trays and fixtures, as in the continuous types. Generally, six trays are placed in the muffle and heated for the proper length of time in the presence of the correct gaseous mixture. This muffle, open at one end only, is equipped with a gas-tight, mechanically operated door, through which the work is charged and discharged. Just inside this door is a second refractory "door" to insure the proper degree of heating of the tray closest to the door.

This type of furnace lends itself admirably to the direct quenching of work, as all trays are held at any temperature desired. The door is opened as many times as necessary, depending on whether the work is quenched piece by piece or in a mass, or whether it is removed to cool in the air or left to cool in an auxiliary cooling zone. These auxiliary cooling zones are of the same size as the carburizing chamber and are capable of being slightly heated, if desired; they also have means for introducing a gaseous mixture that will prevent decarburization while cooling.

In the batch type unit, the inlets for the introduction of the carburizing gases are placed at intervals along the sides of the muffle. An opening is provided in the top of the muffle, close to the charging door, for exhausting the spent gases.

Gas Flow and Distribution

The mixture of carburizing gases used varies with the type of case and quality of product desired. The gaseous hydrocarbons most widely used are methane (natural gas), propane, and butane. These carbon bearing gases are mixed with air, with manufactured gases of several types, with flue gas, or with other specially prepared "diluent" gases.

It is necessary to maintain a continuous fresh stream of carburizing gases to the muffle, as well as to remove the spent gases from the muffle continuously, in order to obtain the correct mixture of gases inside the muffle. A slight pressure is maintained on the muffle to exclude foreign gases.

Fig. 7 shows a side view of a continuous furnace with the burner arrangement, ladder, and catwalk at the top of the furnace for carburizing gas adjustments. The gas inlets enter at the top of the muffle. The illustration also shows to the left a gas preparation unit. Fig. 8 shows another type of gas preparation unit for making the "diluent" gas which is to be mixed with the gaseous hydrocarbon. The gas is cracked inside of alloy steel tubes, which are heated externally. The illustration shows the differential governors that control the flow of gases. The panel board at the right shows the gages that indicate the flow of gases through the orifice meters to the carburizer.

Modernized Through Research

It has been previously mentioned that the case obtained by carburizing is a thin zone of high-carbon steel at the surface of the part, which varies in carbon concentration from highest at the surface to lowest as the case progresses inward. Fig. 9 shows a section that has been broken from a steering gear worm after carburizing and quenching it. Etching in acid brings out the case, which is shown by the dark band at the outside surface. To study the case and learn of its characteristics and type, pieces are cut from carburized parts and highly polished so as to remove all scratches; they are then etched in acid and placed on a microscope, where the structure of the steel can be seen enlarged.

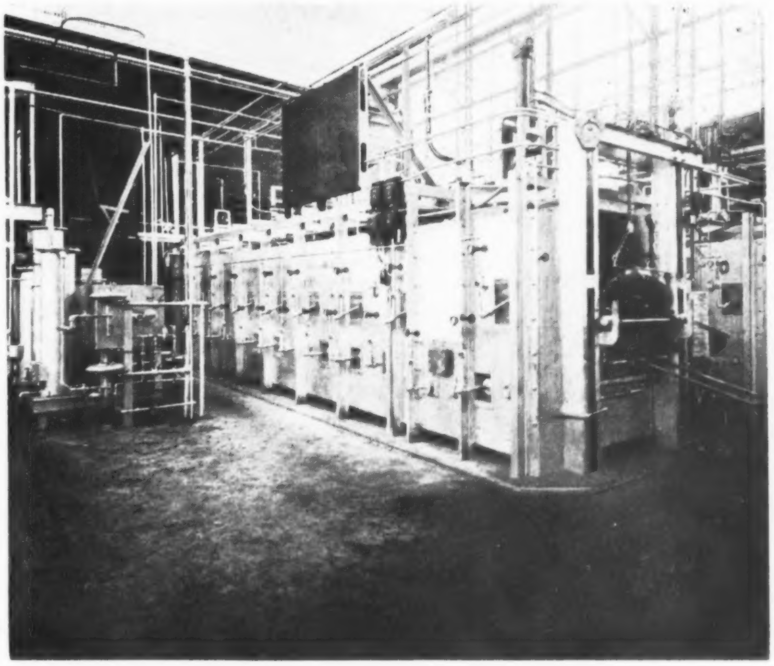


Fig. 7. Side View of Continuous Furnace with a Gas Preparation Unit Shown at Left

Fig. 10 shows the case from a part that was slowly cooled after carburizing. The top of the illustration represents the outer surface of the part. The white network of lines on a dark background is cementite. Below this zone of cementite, or the so-called hyper-eutectoid zone, is a dark zone called the eutectoid zone, which is a mixture of iron and carbon called pearlite because of its resemblance to mother of pearl when seen under the microscope. Below this zone, white spots mixed with dark patches creep in, and as one progresses toward the bottom of the illustration, the white field becomes more prominent, with very few dark spots in it. The third zone is known as the hypo-eutectoid zone, or the one in which the iron is not saturated with carbon. It is sometimes called the "diffusion" zone; by means of this zone a good bond between the case and core is maintained, which prevents the case, when hardened, from peeling off the carburized part.

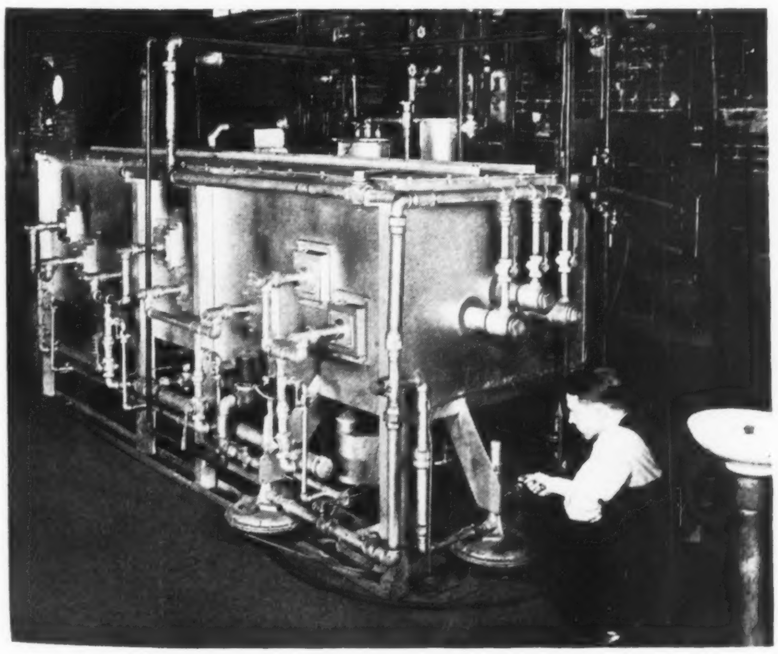


Fig. 8. A Gas Preparation Unit for Carburizing Furnaces; to the Right in the Background is the Panel Board Indicating the Flow of Gases

The fourth zone, at the bottom of the photomicrograph, is known as the core of the object. Here can be seen a large white field of iron mixed with a few black spots which represent the amount of carbon in the steel before the part was carburized. In the illustration, the field seen is 100 times the actual size.

A slowly cooled carburized object is not hard, but can be hardened by heating to the proper temperature in order to drive the excess carbon into solution; the mixture of iron and carbon held in solution, when quenched, yields a hard wearing surface. Fig. 11 shows a photomicrograph of a hard solution such as is desired in most instances. This picture was taken at the surface of a carburized piece at 100 times actual size.

The use of the first-mentioned type of continuous gas carburizer, or the "direct quench and draw" type, has many advantages over the older box method.

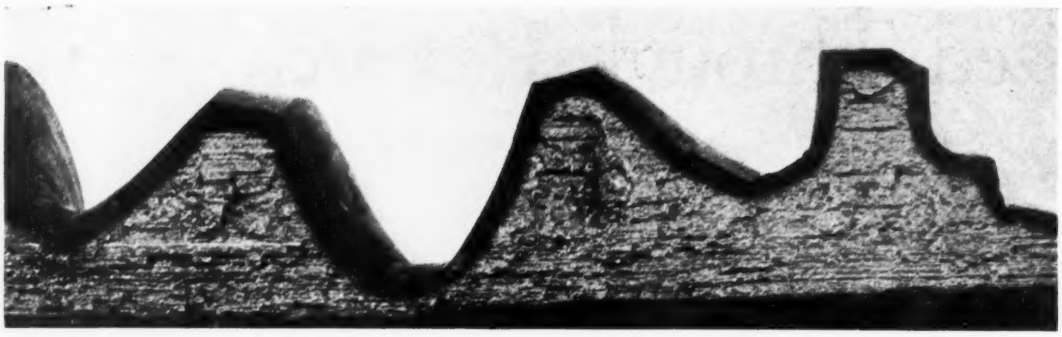


Fig. 9. Section of a Steering Gear Worm, Showing the Carburized Case

They may be summarized as follows: (1) Less labor involved in handling the material. (2) No costly, heavy boxes to pack. (3) No compound to handle and store; hence a great saving in floor space. (4) Less time to obtain a definite case, with great fuel saving. The ratio of total work carburized to the total load heated is much less, due to the elimination of boxes, lids, and compound. (5) Better control over type and character of case. (6) Process can be installed in the production line. (7) Process more adaptable for direct quenching. (8) Total cost per pound of work carburized, including labor, fuel, depreciation on equipment, etc., one-third the cost when using the box carburizing method, as proved by actual experience.

* * *

The taxes placed on the steel industry by the Government in 1937 were equivalent to $330 for every wage-earner. These taxes would have provided a year's pay for 108,000 extra workers.

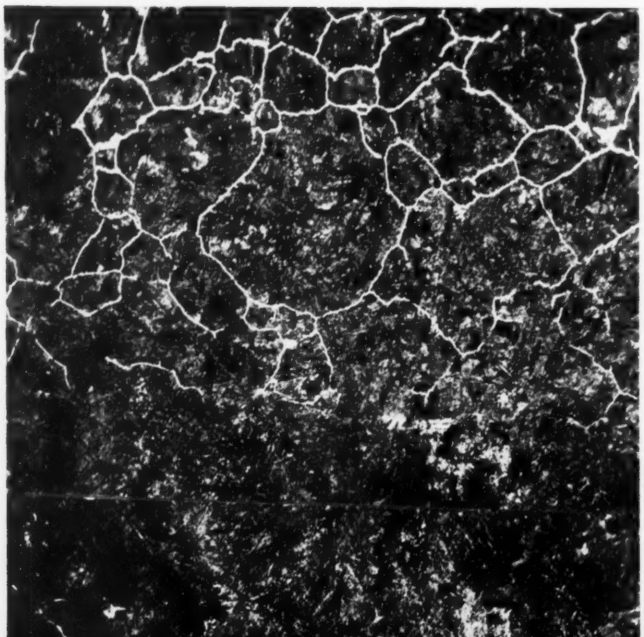


Fig. 10. A Slowly Cooled Carburized Case; the White Area is Cementite. Line across is Due to Two Photographs having been Joined to Show Entire Case

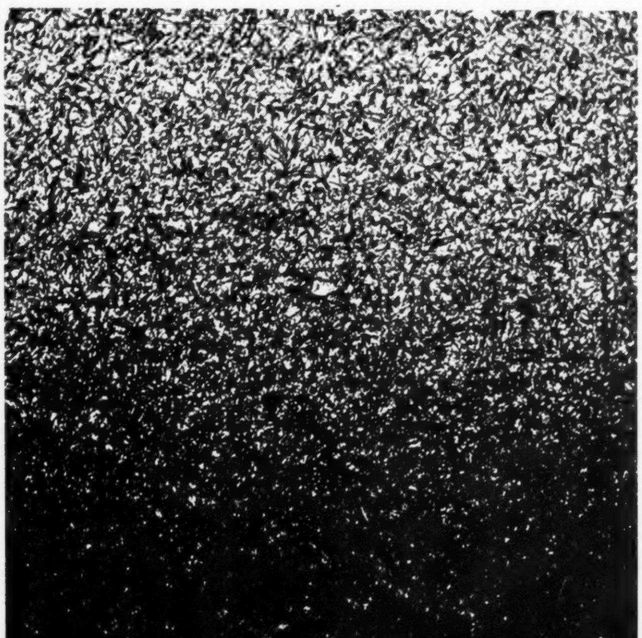


Fig. 11. A Hardened Case, Showing Structure of the Steel. Line across Simply Shows where Two Photographs have been Joined to Show Entire Case

Tool Engineers' Meeting in Pittsburgh

THE American Society of Tool Engineers held its semi-annual meeting at the William Penn Hotel in Pittsburgh, Pa., October 14 and 15. The meeting was attended by over 450 members from every industrial section of the country; the enthusiasm with which the members of this comparatively young society take part in all phases of its activities was everywhere in evidence. James R. Weaver, of the Westinghouse Electric & Mfg. Co., was chairman of the local committee that made the arrangements for this very successful meeting.

At the technical session held Saturday forenoon, October 15, L. W. Chubb, director of research, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., gave an address on the subject "Industrial Advancement through Scientific Research," that showed, in a most interesting manner, the relationship between the achievements of science and the practical results obtained by the application of research. Another thought-provoking address was given at the Society's semi-annual dinner by J. H. Van Deventer, editor of the *Iron Age*, who had chosen for his subject "Tools, Taxes, and Wages."

Not the least interesting part of the program was furnished by the visits to several outstanding industrial plants in Pittsburgh and vicinity. Arrangements had been made to visit the Westinghouse plant at East Pittsburgh, the Homestead Works of the United States Steel Corporation, the Mesta Machine Co., the New Kensington plant of the Aluminum Co. of America, the Firth-Sterling Steel Co.'s plant at McKeesport, Pa., and the Mellon Institute of Research.

The American Society of Tool Engineers, formed in 1932, now has 2700 members, distributed throughout the industrial sections of the United States and affiliated in twenty-two local chapters. In conjunction with the annual meeting of the Society, to be held in Detroit, Mich., during the week beginning March 12, 1939, there will be an exposition of machinery, tools, and materials, which already promises to be of much larger proportions than the successful exposition staged by the Society last March.

* * *

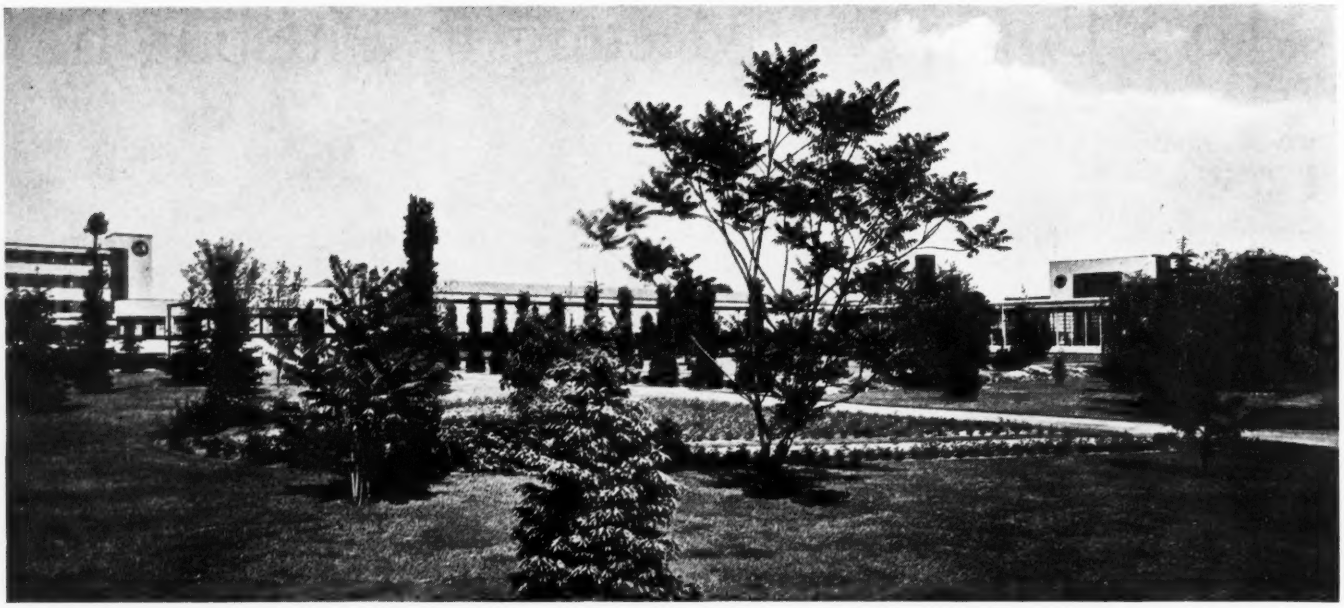
Unusual Cutting Tool Exhibit at the Detroit Metal Show

Approximately eighty well-known machine tool builders and tool manufacturers cooperated with the Carboloy Company, Inc., Detroit, Mich., in presenting to the visitors at the National Metal Exposition held in Detroit during the week beginning October 17, a comprehensive display of the latest types of Carboloy-tipped tools and of modern machine tools designed to use cemented-carbide tools to the best advantage.

The exhibit, which was held in the Carboloy booth at the Metal Show, was composed of two sections. The first, devoted to tools, consisted of tipped-tool samples made by the Carboloy Company and forty-seven other tool manufacturers, who are licensed to furnish tools equipped with Carboloy cemented carbide. Among these tools were shell reamers; chucking reamers; drills for glass, concrete, cast iron, and non-ferrous metals; counterbores; hollow mills; multiple-cutter boring heads; boring-bars; precision boring tools; and saws; as well as gages of many types, lathe and grinder centers, etc.

In the section devoted to machine tools, thirty-one machine tool builders cooperated, furnishing a pictorial presentation of the latest types of machines designed for using cemented-carbide tools.

A Group of the Members of the American Society of Tool Engineers who Visited the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co. during the Society's Recent Meeting in Pittsburgh



Precision Operations in a German Shop

A MILE or two outside of the congested area of Berlin, situated within its own garden-like park and having more the appearance of a summer resort than a factory working with such harsh materials as iron and steel, lies the machine tool plant of Herbert Lindner. Specializing in thread-grinding and jig-boring machinery, this plant ranks among the leading precision machine tool building enterprises in Europe. The accompanying illustrations show a few operations performed in this plant on machines built by the company.

The grinding of threads with multiple-grooved wheels has been highly developed in Europe. This method is used to obtain results rapidly, and gives a high degree of precision; but where the very greatest precision is required, single-thread wheels are recommended. Multiple-thread wheels are made in widths up to approximately 2 1/2 inches.

Fig. 1 shows the grinding of a double-ended internal thread milling cutter having a diameter of about 3/8 inch and eighteen threads to the inch. This tool, shown completed in the illustration, is ground from the solid. The machine is so arranged that the thread is both formed and relieved in the grinding operation. It is of interest to note that the photographs for this and the following illustrations were taken while the machines were running, which is indicative of remarkable freedom from vibration.

Fig. 2 shows the grinding of a thread with a multiple-thread grinding wheel from the solid. In

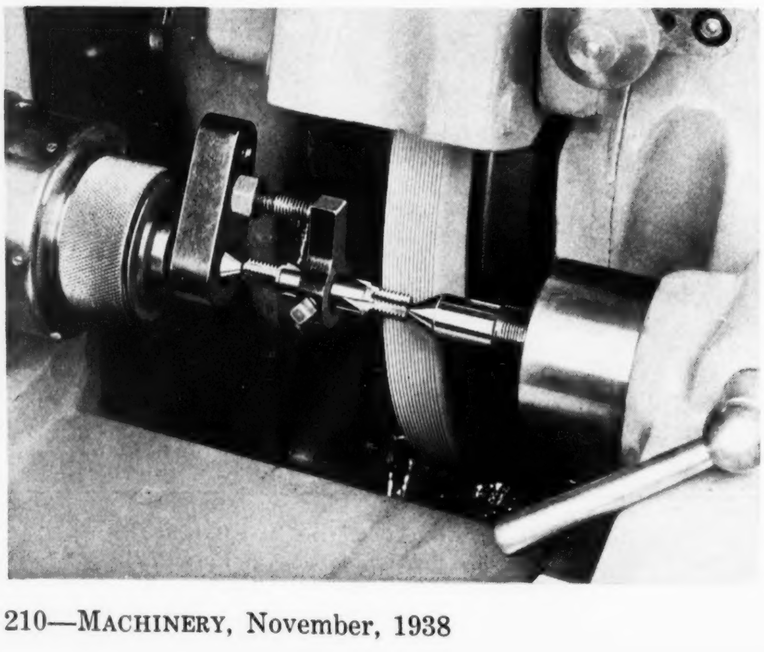


Fig. 1. Grinding the Threads of an Internal Thread Milling Cutter with a Multiple-thread Wheel

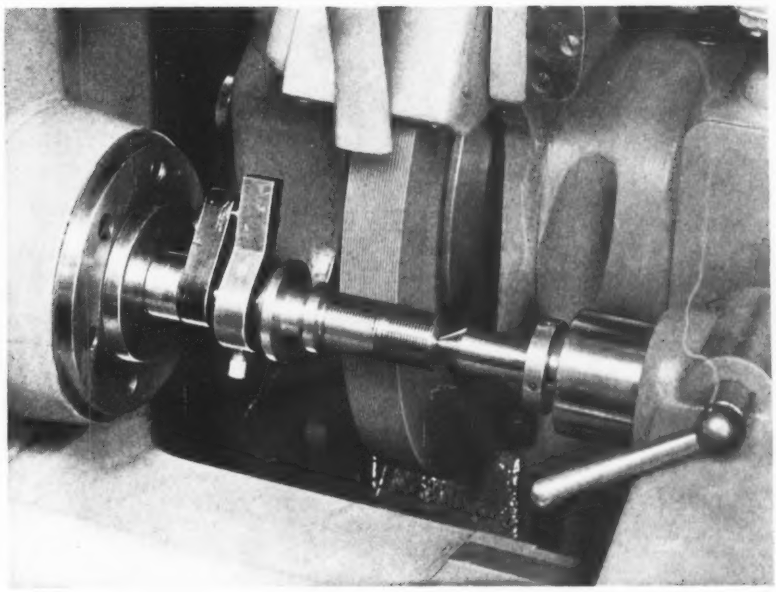


Fig. 2. Grinding a Long Thread with a Multiple-thread Wheel, Necessitating the Moving of the Wheel to a New Position after One Part of the Thread Length has been Ground

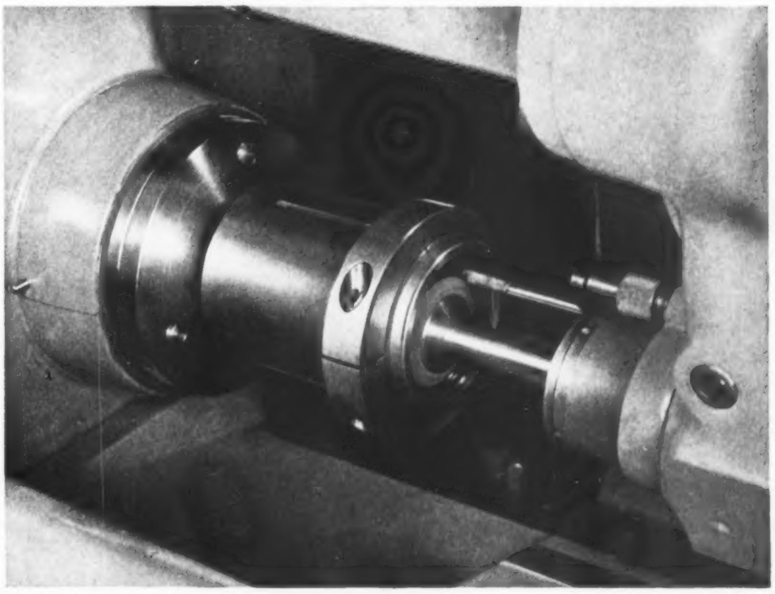
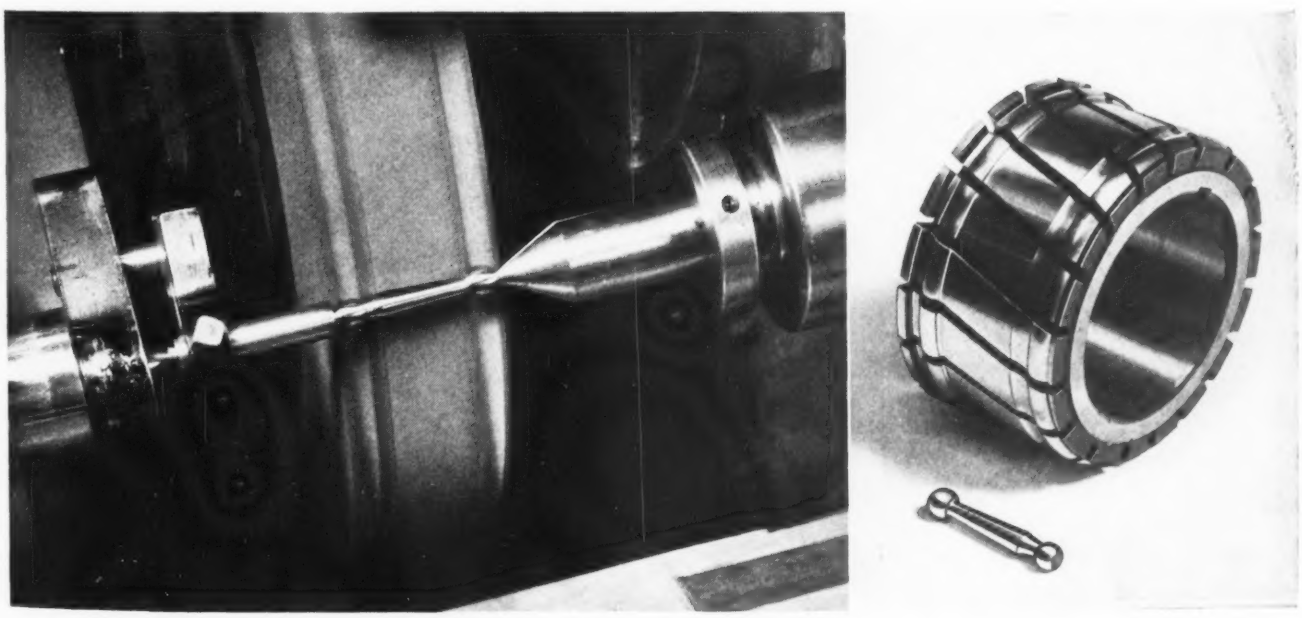


Fig. 3. (Right) Grinding an Internal Thread with a Single-pointed Wheel

Fig. 4. (Below) Using a Thread-grinding Machine for Form Grinding. In the View at the Right May be Seen the Wheel Dresser and the Completed Work



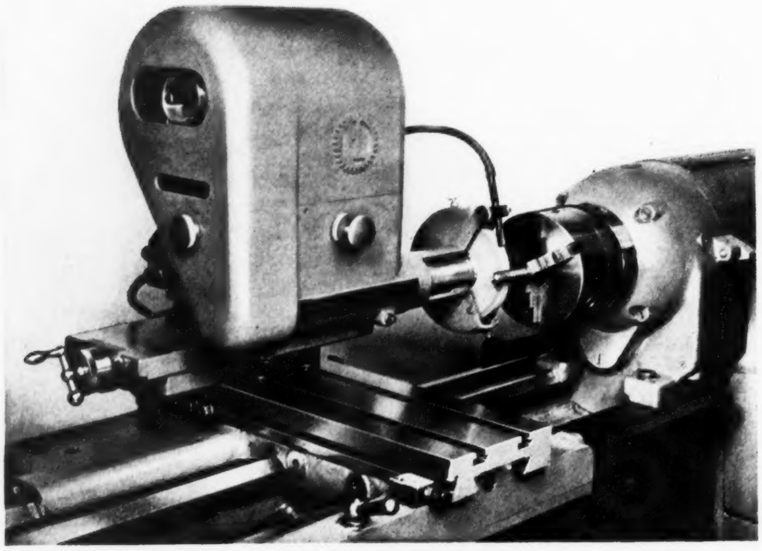


Fig. 5. A Thread-grinding Attachment with Multiple-grooved Wheel Applied to a Lathe

this case, the length of the thread is greater than the width of the wheel. When one part of the thread is completed, the wheel is moved along the work to the next portion to be ground. The accuracy of the mechanism by which this movement of the wheel is controlled, guarantees "catching the thread" for the new section to be ground within 0.0003 inch.

Fig. 3 shows the grinding of an internal thread with a single-pointed wheel. The length of the thread is approximately 3/4 inch and there are twelve threads to the inch. The single-pointed wheel is used to obtain extreme accuracy. However, multiple-thread wheels are also used for grinding internal threads.

Fig. 4 shows an instance of form-grinding on a thread-grinding machine; to the right is shown the wheel dresser and a completed piece of work.

Fig. 5 shows a thread-grinding attachment for a lathe applied to the grinding of threads with a multiple-thread wheel.

The Lindner company also makes a jig-boring machine, very heavily constructed, so that precision operations can be performed, when necessary, on a production basis. Fig. 8 shows this machine applied to the boring of holes at an angle, making use of a universal circular attachment. It is claimed that this circular attachment may be set to such an accuracy that errors in angular divisions will not exceed ten seconds.

Figs. 6 and 7 show the jig-boring ma-

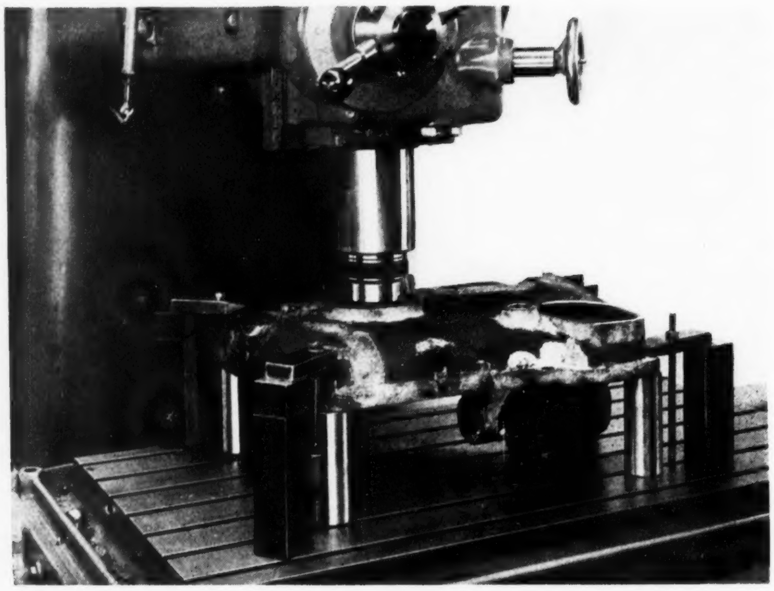


Fig. 6. (Center) Using a Jig-boring Machine for Manufacturing Work. A Milling Operation Performed on the Same Piece is Shown in Fig. 7

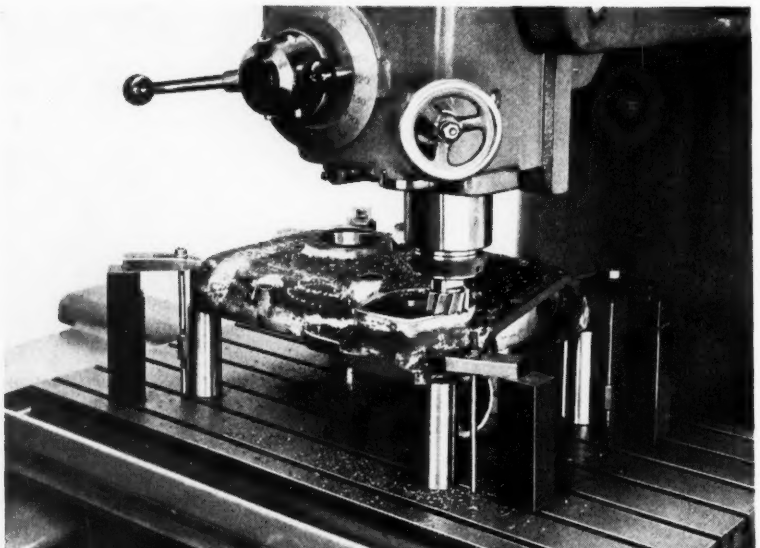


Fig. 7. (Left) Illustration Indicating how Boring and Milling Operations are Performed on the Jig-boring Machine on Manufacturing Work without Resetting

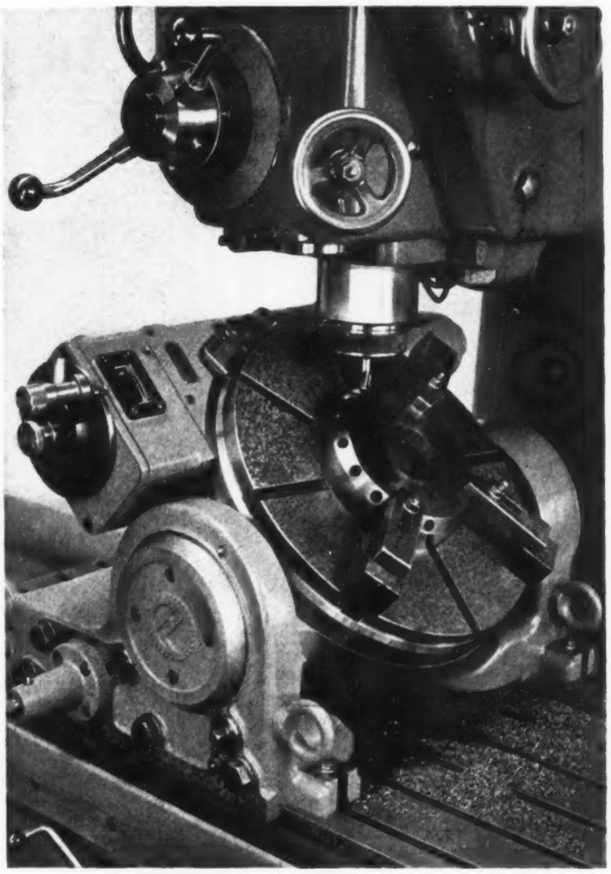


Fig. 8. A Jig-boring Operation, Using a Universal Circular Table that Permits Angular Movements Accurate within Ten Seconds

chine being used on manufacturing work. Since the machine is built heavy enough to permit the taking of substantial milling cuts, it is possible to perform several boring and milling operations with great precision, without resetting the work. This also insures that the milled surfaces will be square with the bored holes.

* * *

International Acetylene Congress

The thirteenth International Congress of Carbide, Acetylene, Oxy-Acetylene Welding and Allied Industries will be held in Munich, Germany, June 25 to July 1, 1939. The purpose of the congress is to discuss questions of scientific, technical and economic interest related to the acetylene industries. The subject of oxy-acetylene welding will receive special emphasis. Further information can be obtained from the International Acetylene Association, 30 E. 42nd St., New York City.

Providence Meeting of Mechanical Engineers

THE American Society of Mechanical Engineers held its fall meeting in Providence, R. I., October 5 to 7. During the meeting, sessions were held pertaining to fuel, rubber, jewelry manufacture, industrial instruments, power, textiles, management, iron and steel, and machine shop practice. Since the meeting was held in such a well-known machine tool building center as Providence, subjects pertaining to machine shop practice were given especial emphasis.

The papers read at the machine shop practice sessions were as follows: "Recent Developments in Thread-Grinding Practice," by Paul V. Miller, manager, Small Tool Division, Taft-Peirce Mfg. Co., Woonsocket, R. I.; "The Refinement of Ground Surfaces," by Herbert S. Indge, lapping engineer, Norton Co., Worcester, Mass.; "Accuracy of Borizing," by Carl T. Guething, sales engineer, The Heald Machine Co., Worcester, Mass.; "Gear Design as Influenced by Modern Loading Practices," by W. P. Schmitter, assistant chief engineer, The Falk Corporation, Milwaukee, Wis.; "How Useful Is Your Sense of Proportion?" by W. E. Johnson, refrigerating engineering department, General Electric Co., Fort Wayne, Ind.; and "Motor Drives and Electric Controls on Machine Tools," by B. P. Graves, director of design, Brown & Sharpe Mfg. Co., Providence, R. I.

A number of visits to outstanding industrial plants in Providence and vicinity constituted one of the features of the meeting. Among these visits, those of especial interest to men engaged in the machinery industries, were two arranged to the Brown & Sharpe Mfg. Co. Every effort had been made to make this visit of the members of the Society as informative and valuable as possible. A large area in the main shop had been set aside for the display of not less than eighteen different sizes and types of machine tools, installed under factory conditions and operating on production jobs. Among these were milling machines, grinding machines, and automatic screw machines in which were incorporated unusual electric, hydraulic, and mechanical controls. Included in this display were also many other products of the company, including a new highly interesting non-electric magnetic chuck.

Another feature of especial interest to the visitors to the Brown & Sharpe plant was the inspection of the constant-temperature gage room, where the gaging and inspecting machines and equipment are mounted on specially constructed vibration-proof foundations. Here demonstrators gave the visitors an opportunity to test the extreme sensitiveness of many of the measuring machines and devices.

Associated Machine Tool Dealers' Meeting

THE annual convention of the Associated Machine Tool Dealers of America was held in Cincinnati on October 10 and 11. The number of machine tool dealers in attendance exceeded that of any previous meeting. The general sessions of the convention were also attended by a large number of manufacturing executives, indicating cooperation between builders and dealers in solving marketing and other problems of common interest.

A. G. Bryant, president of the Bryant Machinery & Engineering Co., Chicago, was re-elected president. John Sauer, Jr., of the Peninsular Machinery Co., Detroit, Mich., will continue to serve as vice-president, while E. P. Essley of the E. L. Essley Machinery Co., Chicago, Ill., will again act as secretary-treasurer. Three new members of the executive committee were elected to serve until 1941: William T. Todd, Jr., Somers, Fitler & Todd Co., Pittsburgh, Pa.; George Habicht, Marshall & Huschart Machinery Co., Chicago, Ill.; and John Cetrule, Triplex Machine Tool Corporation, New York City.

A. G. Bryant Re-elected President of the Associated Machine Tool Dealers of America

The two-day session included many outstanding addresses pertaining to various phases of the industry. Following a welcome to Cincinnati by William J. Radcliffe of the E. A. Kinsey Co., President Bryant delivered the keynote address to introduce the Sales Clinic, a feature of the convention that he so successfully inaugurated at the group's spring meeting at Dearborn, Mich. He stated that dealers must devote increased thought and attention to the analysis and constant improvement of their selling methods and practices. The Sales Clinic, he explained, provides an opportunity for dealers to secure first-hand information regarding methods successfully employed by others and consider the possibility of adjusting practices in their own individual business with a view to increasing their sales efficiency. President Bryant also emphasized his conviction that dealers must continually endeavor to stabilize the volume of the machine tool industry, thus reducing the great fluctuations now occurring from year to year.

George R. Ray, of the Marshall & Huschart Machinery Co., presented a paper on "Sales Control," explaining the system used by his company in providing accurate information to their salesmen, in order to assist them in getting the best results. Mr. Ray stated that he considered it a "sales assistance" rather than a "sales control" system.

The importance of the office to the salesmen was stressed by L. H. Pratt, of Henry Prentiss & Co., Inc., New York City. He favored initiative by the salesman, rather than too much office control. He compared selling machine tools to golf, in that "timing" of sales effort is very important, and "pressing" can often be fatal to success.

Tell Berna, general manager of the National Machine Tool Builders Association, continued the sales theme. Mr. Berna expressed his conviction that the present is an opportune time to buy machine tools, because overhead costs will not be lower and buyers can clear up "bottle-neck" conditions by installing new machines today. Optimistic about the upward trend in machine tool sales, Mr. Berna said dealers can be of assistance to manufacturers by reporting on the performance of machines under actual operating conditions.

Walter E. Blank, foreman of the toolmaking department of the National Cash Register Co., outlined the experience of his company in using machine tools, stating that the dealer has been of real assistance in many ways. He asserted that it is highly important for salesmen to bring to the attention of their customers every new idea or new development in machine tools, as it is often advisable under present competitive conditions to scrap equipment to attain maximum efficiency and produce at minimum cost.

Mason Britton, vice-chairman of McGraw-Hill Publishing Co., spoke on the need for better selling. The speaker favored planned sales talks, and contended that if the talks are properly prepared and the salesman properly trained, fear that such approaches are not successful is without basis.

Colonel Harry A. Toulmin, Jr., of Dayton, Ohio, a member of the Federal Planning Board, addressed the banquet on "Industrial Plant Mobilization." Machine tools will win the next war, according to Colonel Toulmin.

* * *

Above all else, let us substitute sanity, friendliness, helpfulness, and mutual confidence and cooperation in our relations between Government, industry, and labor, instead of attempting to solve our problems in the spirit of prejudice, hatred, bitterness, mistrust, and opposition.—*Matthew Woll, vice-president, American Federation of Labor.*

Machine Tool Builders Discuss the Industry's Problems

THE National Machine Tool Builders' Association met for its thirty-seventh annual convention at Hot Springs, Va., October 17 to 19. At this meeting a great many of the problems confronting industry were discussed and many addresses dealing with important current problems were made.

In opening the meeting, the Association's president, Howard W. Dunbar, vice-president of the Norton Co., Worcester, Mass., called attention to the serious problems of both international and national character that now confront the world, all of which have a bearing on the machine tool industry, its activity, and the solution of its problems. He reviewed the part that the machine tool industry has played in mechanical progress in the past, and then pointed to the prospects for the future.

Wendell E. Whipp, Newly Elected President of the National Machine Tool Builders' Association

"I see before us three great opportunities," said Mr. Dunbar, "first, the continued search for lower manufacturing costs and the reduction of spoilage and waste; second, the need of equipment to manufacture new products, to perfect new inventions; and third, the replacement of our enormous accumulation of obsolete equipment. Let us examine these three possibilities for equipment sales.

"In spite of occasional localized technological unemployment, our progress as a nation depends on increasing the output of our industries, so as to make their products cheaper and increase the income of the workers. This is a commonplace to engineers; but until it becomes a part of our national policy, we cannot have a substantial recovery. Even some of the most prominent labor leaders have publicly called for cooperation with the employer to avoid waste and increase output, so that labor's share may be permanently increased. A general recognition of this simple, fundamental fact would open a vast field for investment, and stimulate revival of the producer goods industries.

© Bachrach

Howard W. Dunbar, Past-president of the National Machine Tool Builders' Association

"I have mentioned the possibility of new products. The processes of invention have not stopped; we are constantly searching for better ways to do things. There are hosts of new things that will find their way into the market as soon as the outlook improves and investors are willing to put their idle funds to work in the industrial production fields.

"The third huge field for machine tool sales lies in the replacement of obsolete equipment. The very fact that business conditions have been unsatisfactory for many years makes certain the existence of a large dormant demand. Those who know the equipment in use in industrial plants today do not need to be told that there is a tremendous field for better methods and better equipment. For some seven years, almost without interruption, our manufacturing corporations have spent less than their depreciation allowance for repair and replacement of facilities. Our power companies have not expanded their capacity in proportion to the widening market for power. We are all familiar with the serious problem that faces our railroads. George Houston states that the supply of locomotives in operating condition has been steadily dwindling. He states that two-thirds of those still on hand, presumably available for service, are over twenty years old.

"The program of our Navy and the Maritime Commission is so large that existing shipyards cannot produce it in any reasonable period of time. To complete the program in hand, we need more ways on which modern ships can be assembled, and more equipment to fabricate parts.

"As we survey these enormous opportunities that lie in the immediate future, we are struck by the fact that, in large measure, the obstacles that have prevented this work are entirely artificial ones, which can and must be removed."

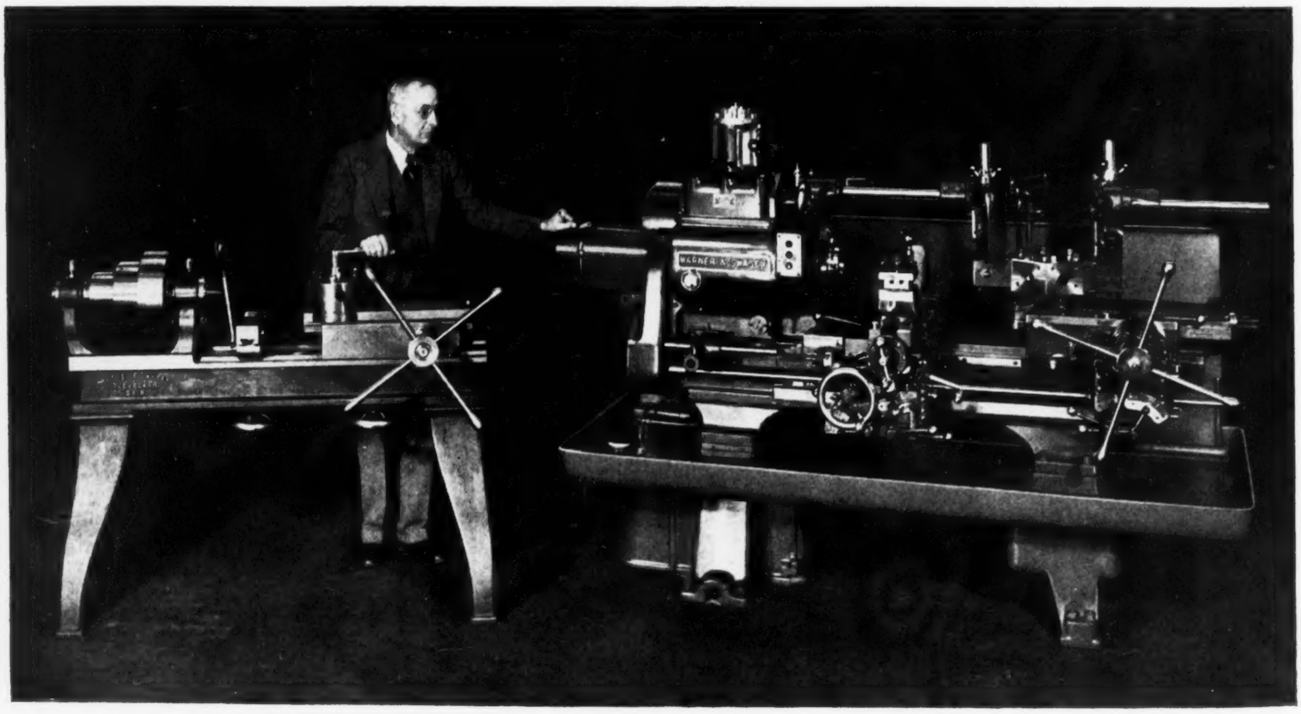
Among other addresses presented before the meeting should be mentioned "Men in Industry," by Colonel W. Chevalier, publisher, *Business Week*, New York; "Logical Liberalism," by Louis Ruthenberg, president, Servel, Inc., Evansville, Ind.; "The Business Outlook," by Dr. Lionel D. Edie, president, Lionel D. Edie & Co., New York; "Is the Customer Always Right?" by Henry G. Weaver, Detroit, Mich.; "Wage Determination under the Walsh-Healy Act," by William J. Kelly, president, Machinery and Allied Products Institute, Chicago, Ill.; "Standardization of Surface Smoothness," by F. O. Hoagland, Pratt & Whitney, Division Niles-Bement-Pond Co.; "Sales Methods in the Machine Tool Industry," by J. Y. Scott, executive vice-president, Van Norman Machine Tool Co., Springfield, Mass.; and "Current Legal Trends and the Machine Tool Industry," by Colonel George T. Buckingham, Chicago, Ill.

The following officers were elected for the coming year: President, Wendell E. Whipp, president of the Monarch Machine Tool Co., Sidney, Ohio; first vice-president, J. E. Lovely, vice-president of the Jones & Lamson Machine Co., Springfield, Vt.; second vice-president, Frederick V. Geier, president of the Cincinnati Milling Machine Co., Cincinnati, Ohio; and treasurer, T. H. Doan, president of the Foote-Burt Co., Cleveland, Ohio. Tell Berna remains general manager, and Mrs. Frida F. Selbert secretary.

Warner & Swasey Co. Completes 50,000th Turret Lathe

ON September 28, the Warner & Swasey Co., Cleveland, Ohio, celebrated the completion of the company's 50,000th turret lathe by inviting to Cleveland executives and works managers of some seventy-five leading American machinery plants. In the forenoon, the visitors inspected the company's shops, where all details of plant operations were thoroughly explained. In the evening, a dinner was given at the Hotel Statler, honoring the company's "twenty-five-year men," at which an address was given by Dr. J. S. Thomas, president of the Chrysler Engineering Institute.

It is of interest to note, in connection with the 50,000th turret lathe, that this machine went to Hartford, Conn., to the plant of the Pratt & Whitney Aircraft Co. This seemed particularly fitting, since the two founders of the Warner & Swasey Co. started in business after having been for many years in the employ of the Pratt & Whitney Co. in Hartford. Another interesting feature in connection with the celebration was a reproduction of the company's catalogue issued in 1887. This catalogue gives an interesting conception of the state of the art of machine tool building fifty years ago.



The 50,000th Turret Lathe Built by the Warner & Swasey Co., Cleveland, Ohio, Compared by George A. Decker, Works Engineer and Oldest Employe of the Company, with a Machine Built by Warner & Swasey when Mr. Decker Joined the Firm in 1882—Fifty-six Years Ago

Gear Manufacturers Association Holds Semi-Annual Meeting

THE twenty-first semi-annual meeting of the American Gear Manufacturers Association was held at Skytop, Pa., October 10 to 12. The unusually well attended meeting offered to the members present a broad program of papers covering both the commercial and the engineering sides of the industry.

In his opening address, the president of the Society, Howard Dingle, president of the Cleveland Worm & Gear Co., emphasized the importance of a statistical index of the activity from month to month in the gear industry. He pointed out that such an index would be more accurate than most other indexes based on industrial production, because the demand for gears reflects more directly than many other industrial products the activity in the entire industrial field.

In concluding his address, Mr. Dingle stated that the immediate trend of business is unmistakably upward. "While," he said, "we may properly have misgivings as to the soundness of any new prosperity built on the foundations now being laid, it is our duty as good citizens to cooperate with our Government in any effort it is making to reduce unemployment. In so doing, however, I do not think it is disloyal or unpatriotic for us as an Association or as individuals to go on record with our Government—local, state, or national—as opposing any measures we do not believe are for the lasting good of our industry."

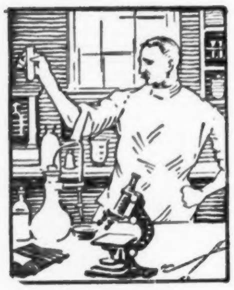
Among the papers read before the meeting, the following should be especially mentioned: "Application of Bronze to Worm-Gearing," by J. A. Hatch, McCallum-Hatch Bronze Co., Inc.; "Measurement and Analysis of Gear Noise," by R. S. Davidson, General Electric Co.; "Buying and Selling," by A. G. Hopcraft, Cleveland Worm & Gear Co.; "Costs and Profits," by W. H. Compton, W. H. Compton & Co.; "Characteristics of General-Purpose Motors," by M. Scott Hancock, Westinghouse Electric & Mfg. Co.; "Business Conditions," by Colonel Chevalier, McGraw-Hill Publishing Co.; "The Application of Gear Motors," by R. S. Marthens, Westinghouse Electric & Mfg. Co.; and "Control of General-Purpose Motors," by N. L. Hadley, General Electric Co.

* * *

In one of its departments, the General Motors Corporation uses the largest Mazda lamp in the world. This lamp is of 50,000 watts capacity and is employed in the styling section to simulate sunlight in the study of automobile designs indoors. There is enough tungsten in the filament of this lamp to make over 125,000 standard 25-watt lamps.

A Group of Members and Guests Present at the Semi-annual Meeting of the American Gear Manufacturers Association at Skytop Lodge, Skytop, Pa.

MATERIALS OF INDUSTRY

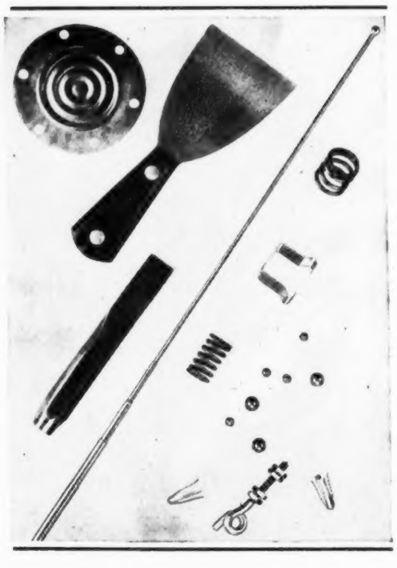


THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Corrosion-Resistant Rolled Strip with High Strength

The corrosion resistance of nickel, combined with the mechanical properties of high-strength alloy steel, are provided in an alloy containing 98 per cent nickel, which is being placed on the market by the International Nickel Co., 67 Wall St., New York City. Heat-treating is utilized to obtain the high strength. "Z" nickel, as the alloy is termed, has a strength of from two and one-half to four times that of ordinary structural carbon steel. It has been produced with a tensile strength as high as 250,000 pounds per square inch and hardness values as high as 46 Rockwell C. In its unhardened or annealed condition, it fabricates almost as easily as pure nickel. Such operations as bending, drawing, machining, and hot-forging are accomplished readily.

The metal can be heat-treated after fabrication with little if any distortion, since heat-treating operations are carried out at low temperatures—890 to 930 degrees F. for six to sixteen hours. The slight discoloration that develops during heat-treatment can be avoided by hardening in an atmosphere of hydrogen, which need not be dried.



Parts Fabricated from "Z" Nickel Include an Automobile Aerial Tip, Flat and Coil Springs, a Scraper, a Chisel and Small Balls

While the commercial production of "Z" nickel is too recent to indicate all of its industrial uses, the alloy has been applied in the manufacture of hand-tools, wire brushes, spring clamps, helical springs, and electrical parts.

The alloy is produced commercially in the form of hot- or cold-rolled strip, in a wide range of sizes and various tempers. It can be supplied either unhardened or heat-treated. Unhardened cold-rolled strip is produced in soft, half-hard or full-hard tempers with minimum tensile strengths, respectively, of 90,000, 130,000, and 155,000 pounds per square inch. Heat-treatment increases these values 30,000 to 70,000 pounds per square inch.

Since the hardening treatment is carried out at a relatively low temperature, the strength and hardness developed by cold reduction or other cold work is largely retained, so that, in effect, the hardening developed by the heat-treatment is superimposed on that produced by the previous cold work. 200

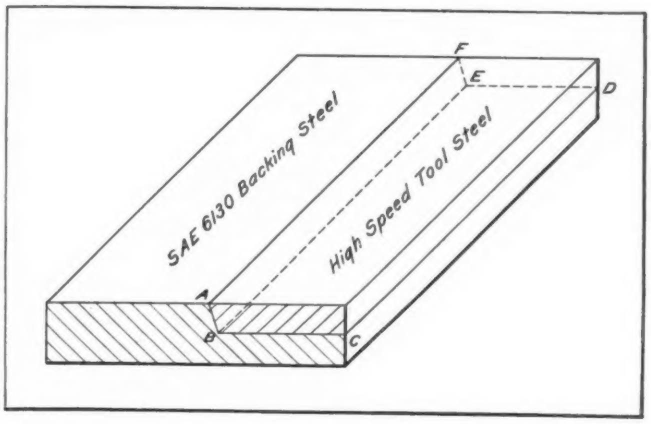
Composite Knife Stock Made in New Way

In the production of composite or "laid" knife stock, the so-called vertical weld represented by the plane *ABEF* in the accompanying sketch generally presents a troublesome problem. Although the weld along the plane *BCDE* may have been previously made satisfactorily, the finished knife often has an unsightly appearance because of irregularities along line *AF* and, in some cases, the vertical weld is not sufficiently strong.

The Jessop Steel Co., Washington, Pa., has developed a method of producing composite knife stock that overcomes these difficulties. The practice followed involves the Armstrong method of electropickling and electrodeposition of iron on the insert prior to assembly. The vertical welding line *AB* is made to a bevel which can be held to a minimum of 10 degrees, if the user desires. Customarily, the bevel is about 15 degrees. Certain variations in the manufacturing technique, for which patents are being sought, have been devised to insure a proper vertical weld in this particular type of composite steel.

Although intended primarily for knife stock, this R-type composite steel can be used for many other applications, including lathe tools, dies, and stone-cutters. High-speed tool steel is generally used for the insert,

To obtain additional information on materials described on this page, see lower part of page 222.



Sketch Showing Beveled Vertical Weld Line Used in Producing Jessop R-type Composite Knife Stock

although high-carbon, high-chromium steel or other alloys can be employed.

The use of S A E 6130 steel for backing, as indicated in the sketch, has proved more satisfactory for knife stock than regular S A E 1010 or 1020 steel on account of its toughness and low amount of grain growth during hardening. Other grades of backing steels, however, may be used in producing this type of composite stock...........201

Copper Alloys Especially Adapted for Marine Uses

A series of hardenable copper alloys produced under license from the Electro Metallurgical Co., Unit of the Union Carbide & Carbon Corporation, 30 E. 42nd St., New York City, is now available for use in various branches of marine engineering and construction. These alloys provide a strong cast metal with relatively high thermal and electrical conductivity and with good resistance to corrosion. The latter quality makes them particularly adapted for use in marine engines and other equipment in which efficient heat transfer is essential. These alloys have proved especially advantageous in automotive cylinder heads, cooled by air alone; they also are suitable for use as electrodes in spot-welding operations and as contact wheels in seam-welding operations.

From a commercial standpoint, the most important members of this series are copper alloys hardened by the precipitation of silicides of chromium, cobalt, or nickel. A hardenable copper-chromium alloy is also of some importance. Patents cover other hardenable copper alloys containing such elements as cobalt, high silicon, and high silicon nickel; however, the commercial use of these alloys is limited at present; but it is quite possible that they may find more extensive applications in the future.

For a copper alloy having the highest possible electrical conductivity, combined with considerable strength, the chromium content ranges from 0.50 to 1.00 per cent and the silicon content from 0.06 to 0.12 per cent. Such an alloy, when properly heat-treated, will have a yield point of 35,000 pounds per square inch, an ultimate strength of 50,000 pounds per square inch, and an electrical conductivity equal to 85 per cent that of pure copper. The hardness ranges from 50 to 55 Rockwell B scale.

Castings with an ultimate strength up to 75,000 pounds per square inch can be produced from alloys of the nickel-silicide composition. The hardness of these alloys, on occasion, has exceeded 200 Rockwell, but the electrical conductivity may not be more than 40 per cent that of pure copper. The cobalt-silicide alloy has properties intermediate between the chromium-silicide and the nickel-silicide alloys. 202

Failure of the Propeller Shaft on a Fishing Boat is a Real Disaster because of the Perishable Nature of the Cargo. Accidents of This Kind have Led to the Adoption of Monel Propeller Shafts which cannot be Harmed by Sea Water. This Illustration Shows a 6 5/8-inch Diameter Monel Shaft being Installed in a Tuna Clipper on the Pacific Coast

To obtain additional information on materials described on this page, see lower part of page 222.

NEW TRADE  LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 221 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the November Number of MACHINERY.

Gages

PRATT & WHITNEY, DIVISION NILES-BEMENT-POND CO., Hartford, Conn. Catalogue 10, containing 206 pages showing some of the many gages and precision gage-blocks made by this concern, including plug and ring gages, thread snap gages, pipe thread gages, supermicrometers, electrolimit comparators, and the Pratt & Whitney standard measuring machine. The last section of the book contains reference tables of value to gage users. 1

Standardized Bearings

BUNTING BRASS & BRONZE CO., Toledo, Ohio. Enlarged catalogue listing hundreds of different sizes of completely machined and finished standardized bearings, including cast-bronze sleeve type bearings and electric motor bearings; other products included are precision bronze bars, graphited cast-bronze oil-less bearings, and babbitt metals. 2

Steels

ALLEGHENY LUDLUM STEEL CORPORATION, Brackenridge, Pa. Pamphlet entitled "Twin Engined for Progress," containing information on the recent merger of the Allegheny Steel Co. and the Ludlum Steel Co. The booklet describes present facilities, assets, and products, and outlines the plan of action of the combined organization. 3

Motor-Driven Attachments for Milling Machines

DALRAE TOOLS CO., Syracuse, N. Y. Catalogue illustrating and describing two motor-driven attachments for milling machines — one called the "Speedmill" for milling operations, and the other called the "Midgetmill" for milling, drilling, and boring. 4

Press Safety Attachments

WIESMAN MFG. CO., 4th and St. Clair Sts., Dayton, Ohio. Circular on leader-pin covers for protecting press operators and preventing dirt or scrap from getting on the pins or bushings. Folder illustrating various press safety guards, as well as leader-pin covers. 5

Ball Bearings

MARLIN - ROCKWELL CORPORATION, Jamestown, N. Y. Bulletin 26, in a series on "Ball Bearing Practices for the Shop Man," containing a list of over 10,000 ball bearings of various makes in numerical order, and corresponding sizes of M-R-C ball bearings. 6

Cadmium Plating

OAKITE PRODUCTS, INC., 14 Thames St., New York City, in the September-October issue of *Oakite News Service*, published an article entitled "Cadmium Plating of Steel," describing cadmium plating practices and methods of preparing the steel for the plating bath. 7

Ball and Roller Bearing Lubrication

TEXAS CO., 135 E. 42nd St., New York City. Publication entitled "Ball and Roller Bearing Lubrication," illustrating and describing, in great detail, the methods and type of lubrication suitable for anti-friction bearings. 8

Taps

WINTER BROS. CO., Wrentham, Mass. Booklet, of convenient vest-pocket size, containing information on various kinds of taps and the correct method of using them on different classes of work to obtain greater production and better quality work. 9

Milling Cutters

SEVERANCE TOOL MFG. CO., 1532 E. Genesee Ave., Saginaw, Mich. Catalogue 12, describing Severance Midget milling cutters, designed to suit a wide range of work in the automobile field, Diesel engine field, etc. 10

Certified Steels

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. 1939 Stock List, containing complete listings and descriptions of the wide range of certified steels and allied products carried in stock for immediate shipment by the company. 11

Hydraulic Presses

LAKE ERIE ENGINEERING CORPORATION, Buffalo, N. Y. Bulletin 138, illustrating several examples of the adaptability and economy of hydraulic presses for limited as well as larger production in the metal-working industry. 12

Metallizing Equipment

METALLIZING ENGINEERING CO., INC., 44 Whitehall St., New York City. Bulletin P 10, descriptive of the metallizing process and Metco equipment. Bulletin 37, illustrating and describing the Metco metallizing gun. 13

Heat-Treating Equipment

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Catalogue N33, illustrating the Micromax pyrometer for automatically controlling the temperature in heat-treating furnaces. 14

Milling Machines

SUNDSTRAND MACHINE TOOL CO., 2530 Eleventh St., Rockford, Ill. Bulletin 382, describing the features and advantages of the No. 0 Rigidmil, made in two styles—with hydraulic and hand feed. 15

Bench Machine Tools

BURKE MACHINE TOOL CO., Conneaut, Ohio. Bulletin covering the line of bench machine tools made by this concern, including motor-driven milling machines, drill presses, and friction-driven tapping machines. 16

Precision Measuring Machines

PRATT & WHITNEY, DIVISION NILES-BEMENT-POND Co., Hartford, Conn. Circular 441, descriptive of the Pratt & Whitney standard measuring machine, which reads directly to 0.00001 inch. 17

Welding Machines

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Circular 26-140, descriptive of the Flexarc 200-ampere welder for rural and field service where power supply is not available. 18

Blueprinting Machines

SHAW BLUEPRINT MACHINE Co., INC., 9-11 Campbell St., Newark, N. J. Circular illustrating and describing the Shaw Model M continuous blueprinting machine equipped with washing and drying units. 19

Electric Arc Welder

COMMONWEALTH MFG. CORPORATION, 4208 Davis Lane, Cincinnati, Ohio. Circular outlining the distinctive features of the Model 120-UL continuous-duty electric arc welder made by this company. 20

Geared-Head Lathes

SEBASTIAN LATHE Co., Cincinnati, Ohio. Circular outlining the principal features of the Sebastian Type S geared-head lathes. Specifications are given for the three sizes—12-, 16-, and 20-inch swing. 21

Oil-Groovers

FISCHER MACHINE Co., 310 N. 11th St., Philadelphia, Pa. Bulletin illustrating and describing Fischer oil-groovers and the relieving and taper attachment with which these machines are equipped. 22

Air-Turbine Grinder

ONSRUD MACHINE WORKS, INC., 3940 Palmer St., Chicago, Ill. Circular entitled "75,000 R.P.M. at Your Finger Tips," describing the B-1 air-turbine grinder made by this company. 23

Toolmaker's Vise

FRAY-MERSHON, INC., 515 W. Windsor Road, Glendale, Calif. Bulletin illustrating and describing the "All Angle" toolmaker's vise, a portable multi-swivel vise designed to hold work at any angle. 24

Abrasive Cut-Off Machines

TANNEWITZ WORKS, Grand Rapids, Mich. Circular descriptive of Tannewitz abrasive cut-off and miter machines, made with a swiveling cutting unit and in both bench and floor types. 25

Flexible Couplings

SHALLCROSS Co., 48th and Grays Ferry Road, Philadelphia, Pa. Circular containing descriptive matter, including specifications and prices, covering the Wood line of flexible couplings. 26

Tapping Machines

PROCUNIER SAFETY CHUCK Co., 16 S. Clinton St., Chicago, Ill. Bulletin 38, illustrating and describing a new Procunier universal tapping machine for small, sensitive, high-speed tapping. 27

Nickel Alloys

INTERNATIONAL NICKEL Co., INC., 67 Wall St., New York City. Revised edition of Bulletin T-4, entitled "Methods for the Fabrication of Nickel-Clad Steel Plate." 28

Die-Heads

MURCHEY MACHINE & TOOL Co., 951 Porter St., Detroit, Mich. Circular illustrating and describing Murchey tangential-chaser self-opening die-heads. 29

Light Reflectors

WESTINGHOUSE ELECTRIC & MFG. Co., Lighting Division, Cleveland, Ohio. Catalogue Section 61-153, on "Locklite" reflectors and hoods for industrial lighting. 30

Hydraulic Broaching Machines

NIXON GEAR & MACHINE Co., INC., Syracuse, N. Y. Circular illustrating and describing Nixon hydraulic broaching machines and presses. 31

Steel Castings

NATIONAL-ERIE CORPORATION, Erie Pa. Catalogue containing views

To Obtain Copies of New Trade Literature

listed on pages 220-222 (without charge or obligation) mark with X in the squares below, the publications wanted, using the identifying numbers at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
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Name .... *Position or Title* ....

[This service is for those in charge of shop or engineering work.]

Firm ....

Business Address ....

City .... *State* ....

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showing the methods used at this plant in making steel castings, and examples of some of the products. 32

Portable Electric Tools

BLACK & DECKER MFG. CO., Towson, Md. Circular containing information on the Black & Decker "Holgun," a portable electric drill with pistol grip and trigger switch. 33

Bench Grinders

STANLEY ELECTRIC TOOL DIVISION, STANLEY WORKS, New Britain, Conn. Leaflet descriptive of the Victor No. 66 1/4-horsepower ball-bearing bench grinder for general shop use. 34

Rebuilt Machine Tools

J. L. LUCAS & SON, INC., 3 Fox St., Bridgeport, Conn. Catalogue 86, listing this company's stock of rebuilt machine tools of all types, as well as new equipment. 35

Electric Drill Drives

WODACK ELECTRIC TOOL CORPORATION, 4627 W. Huron St., Chicago, Ill. Bulletin 385, containing information on the Wodack "Do-All" electric hammer and drill. 36

Electric Soldering Tools

IDEAL COMMUTATOR DRESSER CO., 1227 Park Ave., Sycamore, Ill. Circular descriptive of a complete line of electric soldering tools known as "Thermo-Grips." 37

Die-Casting Machines

VICTOR DIE CASTING MACHINE CO., 1727 Standard Ave., Glendale, Calif. Leaflet illustrating and describing the improved model Victor die-casting machine. 38

Cold-Drawn Tubing

SUMMERILL TUBING CO., Bridgeport, Pa. Circular entitled "In What Light Do You Look at Tubing?" outlining the advantages of cold-drawn tubing. 39

Grinding Machines

LANDIS TOOL CO., Waynesboro, Pa. Catalogue RW-38, illustrating and describing the new Landis No. 2 Race-A-Way grinder. 40

Pipe Tools

BEAVER PIPE TOOLS, INC., Warren, Ohio. Condensed Catalogue 438, containing data on die-heads, pipe cutters, tool-steel reamers, etc. 41

Tools

WESSON CO., 1050 Mt. Elliott Ave., Detroit. Mich. Circular illustrating Wesson universal vises, counterbores, and standard and special holders. 42

Sheet Drilling Machines

AVEY DRILLING MACHINE CO., Cincinnati, Ohio. Bulletin A-38, illustrating a machine designed for aircraft sheet drilling. 43

Drilling Machines

BUFFALO FORGE CO., Buffalo, N. Y. Bulletin 3122, illustrating and describing the Buffalo No. 16 power-feed drill. 44

Electric Welding Equipment

THOMSON-GIBB ELECTRIC WELDING CO., 170 Pleasant St., Lynn, Mass. Bulletin 307, illustrating and describing the Model B spot-welder. 45

Roller Chains and Sprockets

CHAIN BELT CO., Milwaukee, Wis. Catalogue 333, containing price lists covering the Rex line of roller chains and sprockets. 46

Clutches

INDUSTRIAL CLUTCH CO., Waukesha, Wis. Circular descriptive of the Servo-action clutch for punch presses. 47

* * *

Machinery Group Meeting at Foreign Trade Convention

At the National Foreign Trade Convention held in New York beginning October 31, a group meeting was devoted to the foreign trade interests of the machinery industry. Lewis M. Lind, chief of the Machinery Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C., made arrangements for this meeting and helped in conducting the discussions.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 223-240-H is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 223-240-H—or write directly to the manufacturer, mentioning machine as described in November MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
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Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 218-219 mark with X in the squares below, the identifying number found at end of each description on pages 218-219—or write directly to the manufacturer, mentioning name of material as described in November MACHINERY.

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Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Huge Cylindrical Grinder with Traveling Wheel-Head

The Norton Co., Worcester, Mass., has just completed what is believed to be the longest grinder of its type in existence. This huge grinder will accommodate work up to 36 inches in diameter and 40 feet long. Straight rolls and long solid or hollow shafts can be ground straight and round in this machine within extremely close limits of accuracy, and taper work up to 5 degrees included angle can be ground by swiveling the work-table.

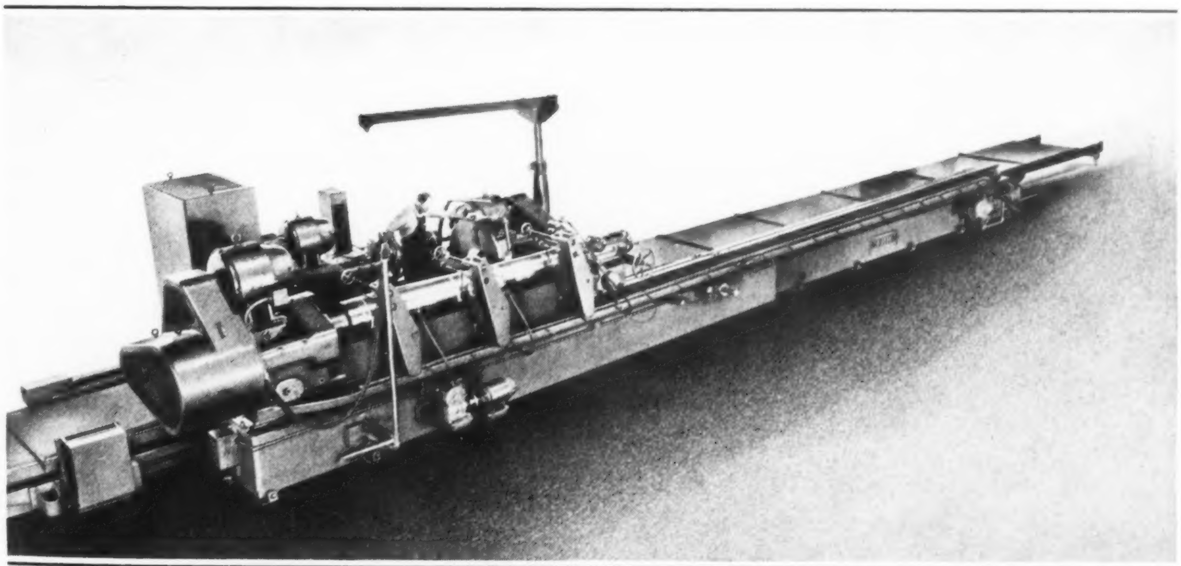
The first test piece ground on this machine was a hollow tube 4 inches in diameter by 16 feet 8 inches long. This tube was ground round within the required tolerance of 0.0002 inch and straight within 0.00025 inch. This exceptional accuracy for so large a machine was required to meet the customer's specifications, which were based on grinding a machinery steel shaft 4 inches in diameter and 33 feet long straight within 0.0008 inch and round within 0.0002 inch. The accurate method of aligning the 60-foot base ways made it possible to produce almost perfectly straight work.

The over-all length of this machine is 80 feet. The base is 8 feet wide, the rear portion having scraped ways 4 feet apart and 6 inches wide for supporting the table on which the wheel-head and all the driving and control mechanisms are mounted. The entire top surface of the front portion is hand-scraped. The swiveling work-table is placed on this surface, which is flat within extremely close limits.

The headstock is movable along the work-table and is driven by an adjustable-speed 15-horsepower motor. The footstock, of the sliding spindle type, is provided with a worm and gear reduction for easy movement of the spindle by handwheel. Both headstock and footstock centers are 4 1/2 inches in diameter, and are equipped with grease-gun connections, which permits forcing lubricant to the center points while the work is revolving on the centers.

The swivel-table is pivoted on the base near the right end, and is moved at the left end by means of a screw driven by a 3-horsepower motor. Graduated scales and verniers near the swivel adjustment screws permit very accurate settings for tapered work. The top of the base on which the table swivels is lubricated through a row of grease-gun fittings for the entire length of the table.

In testing the machine for



Norton Cylindrical Grinder with Capacity for Grinding Work 36 Inches in Diameter by 40 Feet Long

To obtain additional information on equipment described on this page, see lower part of page 222.

grinding tapers, a steel shaft 18 inches in diameter at the large end was ground with a taper of 4 degrees included angle, 80 inches long, within a total error limit of 0.0025 inch on the diameter or 0.0003 inch per foot from the original setting of the swivel-table to the vernier scales without subsequent adjustment of the table.

The table that travels on the base ways has a flat top 18 feet 6 inches long and 4 feet 6 inches wide, on which is mounted the grinding-wheel head, with its motor and cross-feed mechanism, the table traverse mechanism, lubricating and coolant pumps, and the electrical control apparatus for the whole machine. The starting, stopping and speed of each motor is controlled by the operator through push-buttons without leaving his position beside the grinding wheel.

The grinding-wheel head is provided with a micrometric hand-feed and a motor-driven rigid cross-traverse. The grinding wheel, which is 42 inches in diameter, with a 3-inch face, is driven by a 25-horsepower, adjustable-speed motor mounted on a sliding base on the wheel-slide through multiple V-belts. A separate motor-driven unit on the wheel-slide supplies cool and filtered oil under pressure to the wheel-spindle and end-thrust bearings.

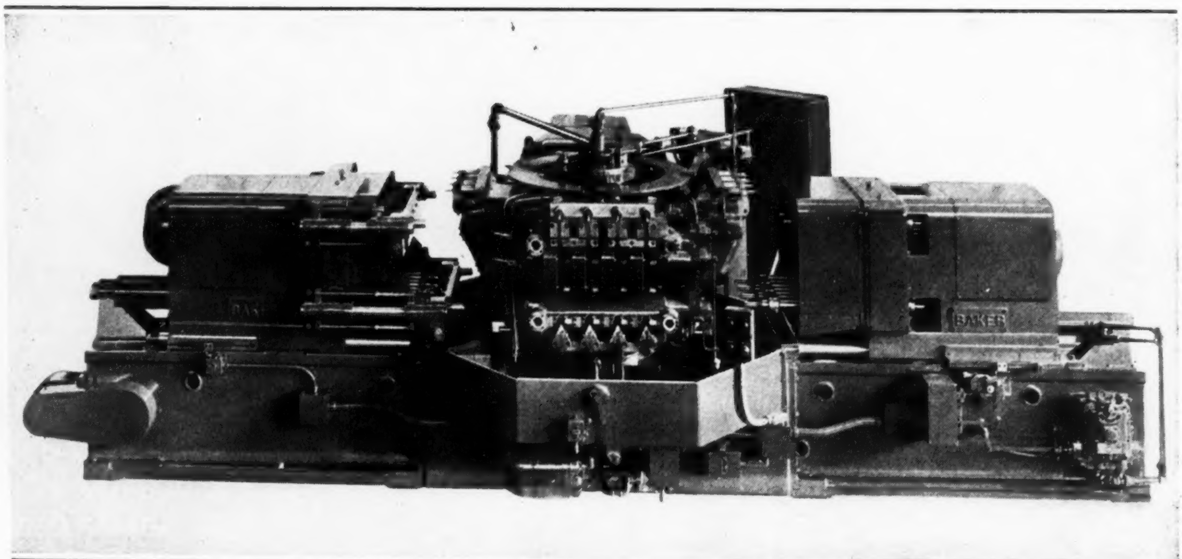
Ten steadyrests are provided, with capacities for work from 4 up to 24 inches in diameter. Coolant is pumped from the 3000-gallon tank located in the foundation of the machine through a mechanical type filter. A pipe line with outlets 21 inches apart affords convenient connection of steadyrest coolant hose at any position throughout the length of the work-table. A total of eight motors ranging from 1/4 to 25 horsepower are required for operating this machine. The total weight of the machine is 185,000 pounds. 51

Baker Three-Way Drilling and Tapping Machine

A three-way unit type drilling and tapping machine with improvements designed to reduce operator fatigue, increase the life of the machine at a minimum cost for maintenance, and lower production costs, has been built recently by Baker Bros., Inc., Westlake and Post St., Toledo, Ohio. The unit construction of this machine permits it to be easily changed over to meet the requirements of different drilling and tapping jobs. The machine illustrated is equipped for drilling and tapping two holes in drop-forged steering knuckle support arms. The holes are 17 inches between centers and are of different sizes, the hole at one end of the work having a special thread 0.752 inch in diameter, while the special thread at the opposite end is 1.140 inches in diameter.

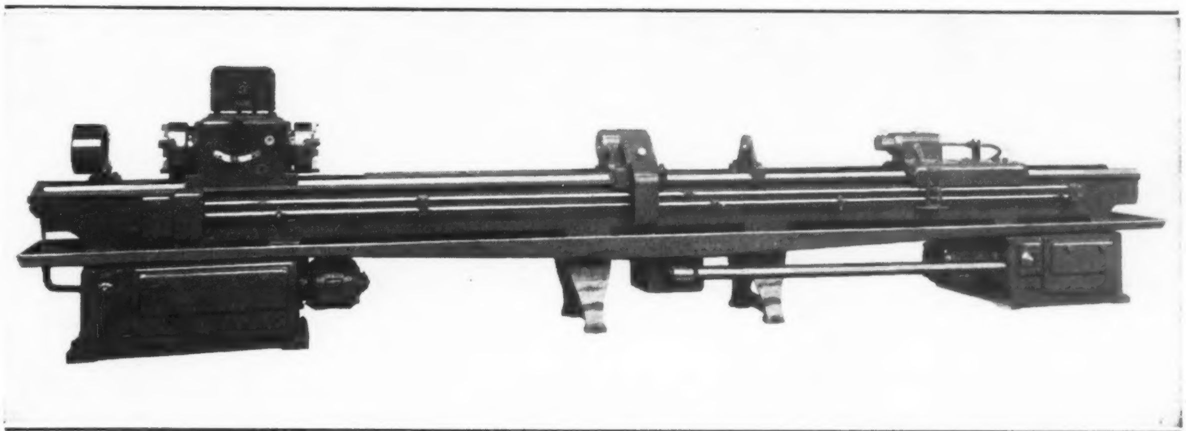
The work is held in four fixtures mounted on the four faces of a square indexing turret, the opposite faces of which are 32 inches apart. Each fixture is arranged for chucking four parts, which are hydraulically clamped and located by two dowel-pins that are also hydraulically actuated. With this arrangement, it is only necessary for the operator to remove the parts and place new parts in the fixtures at the loading station at the front of the machine.

The indexing turret is mounted on large-size ball bearings carried by a heavy upright casting at the center of the machine bed. The turret is indexed automatically so that each of the four work-holding fixtures is brought successively into the operating position in front of the three machining units, each of which is equipped with eight spindles. These units are spaced 90 de-



Baker Three-way Machine Equipped for Drilling and Tapping Forged Steering Knuckle Support Arms

To obtain additional information on equipment described on this page, see lower part of page 222.



Lathe Developed by the R. K. Le Blond Machine Tool Co. for Drilling, Boring, and Reaming Deep Holes

grees apart, one being located at the left of the turret, one at the rear, and one at the right, so that the fourth indexing movement brings one set of fixtures around to the loading station at the front of the machine.

The turret is indexed to the left, or clockwise, bringing the work into position in front of the unit to the left for the first operation. A vertical index-plunger provides approximate location of the turret, final location of each fixture being obtained by four pilot-bars on the head which enter four bushings in each fixture.

The four lower spindles of the head at the left drill 1 5/64-inch holes, while the four upper spindles drill 5/8-inch holes. The eight holes drilled by this head are reamed and chamfered by the head at the rear of the machine and tapped by the head at the right.

The units are operated in unison, the cycle being automatic, with electric interlocked control. Safety features prevent the turret from being indexed until the heads are in a clear position, and the heads cannot be advanced while the turret is indexing. The tapping unit to the right has a hydraulic mechanism for fast, rapid traversing of the head and lead-screw for tapping. This unit is driven from a reversing motor which is automatically controlled during the cycle of the unit. Lubricant is supplied to all tools by a centrifugal motor-driven pump. 52

LeBlond Deep-Hole Drilling, Boring, and Reaming Lathe

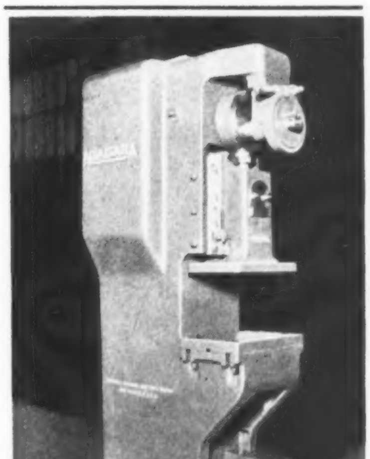
A new deep-hole drilling, boring, and reaming lathe has just been brought out by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. This lathe has been designed to meet the gun boring requirements of the Government, and also to qualify for various applications in the industrial field, such as boring holes for hydraulic cylinders, oil-well casing, and similar work. The lathe developed to meet Government requirements will handle stock 96 inches long with an outside diameter of 5 1/4 inches, and will bore holes up to a diameter of 1 1/2 inches. For industrial use, the machine can be adjusted to take stock of any length and of 5 1/4 inches outside diameter for boring holes up to 2 1/2 inches in diameter.

The hydraulic feed mechanism provides uniform feeds from 0.0006 inch at 500 revolutions per minute up to 0.380 inch at 20 revolutions per minute of the spindle. Stops disengage the feed when the carriage reaches the required limits, and a safety stop comes into action when overloads occur, causing the safety pin to be sheared. The headstock spindle has speeds ranging from 20 to 515 revolutions per minute obtained by means of a 20-point field rheostat, and three mechanical changes of speed provided by sliding gears in the headstock.

A self-contained cooling system equipped with a motor-driven coolant pump having a capacity of 15 gallons per minute and 500 pounds maximum pressure supplies the tool with a steady flow of coolant. 53

Niagara Streamline Punch Presses

A new line of streamline punch presses with the gearing, clutch, flywheel, drive, and motor all enclosed within the steel casting that comprises the frame has been added to the products of the Niagara Machine & Tool



Niagara Streamline Press

To obtain additional information on equipment described on this page, see lower part of page 222.

Works, 637-697 Northland Ave., Buffalo, N. Y. The gearing and sleeve clutch are enclosed in a separate compartment within the frame and operate in a bath of oil. Accessibility of all enclosed working parts is provided by a removable steel plate. The treadle is provided with a cover to safeguard the operator.

The box-section flanged slide is equipped with a knock-out, and operates in adjustable multiple V-gibs, being driven by a large overhead eccentric and steel connecting-rod. A Niagara fourteen-point engagement sleeve clutch with built-in single-stroke mechanism is standard equipment. 54

Giddings & Lewis Boring, Drilling, and Milling Machine

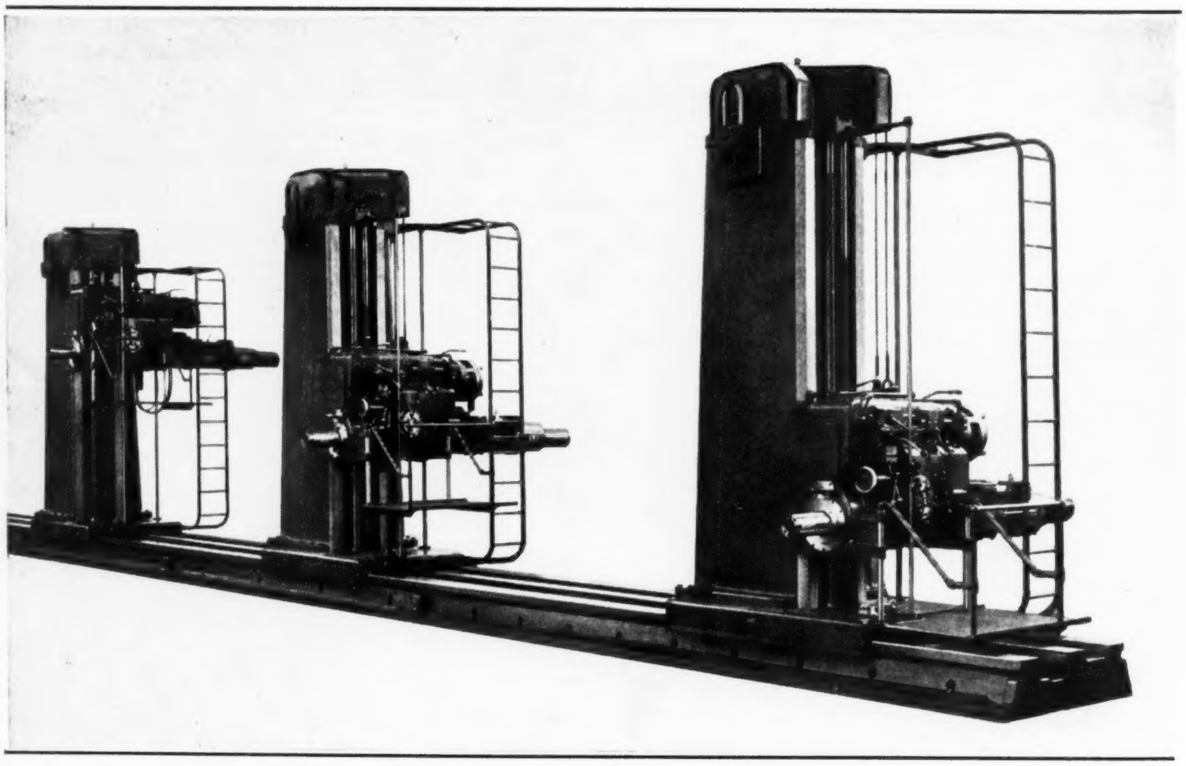
A triple high-power precision floor type horizontal boring, drilling, and milling machine has been completed recently by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. This machine comprises three independently operated floor type machines with a headstock travel of 84 inches, all three units being mounted on a runway 102 feet in length. The maximum distance between the centers of the first and third unit spindles is 90 feet.

Each machine unit is equipped with a main spindle 6 inches in diameter which has a continuous feed of 48 inches, and a high-speed auxiliary spindle 2 inches in diameter which has a continuous feed of 9 inches. The main spindle has thirty-six speeds ranging from 6.25 to 375 revolutions per minute. The high-speed spindle has thirty-six speeds ranging from 25 to 1500 revolutions per minute. The mechanism for selecting spindle speeds, as well as boring, drilling, and milling feeds, is contained in the headstock and is operated by a 15-horsepower motor. The rapid traverse of each headstock on the column and of the column on the runway is 120 inches per minute.

The machine illustrated is used for the simultaneous machining of large marine and industrial Diesel engines, water turbines, generators, steam condensers, and similar large units. It is also used in steel fabricating plants for boring, drilling, and milling large welded and riveted girders. The total weight of this equipment is 230,000 pounds. Six flat cars were required in its transportation. 55

Lincoln "Softweld" Electrode for Cast-Iron Welding

A heavily coated shielded-arc electrode designed for depositing a soft machineable alloy on cast iron has been brought out by the Lincoln Electric Co., 12818 Coit Road, Cleveland, Ohio. This electrode, designated the "Softweld," is adapted for use in correcting machining errors, filling up defects, and producing a very soft machineable weld in gray cast iron. It is made in rods 5/32 inch in diameter by 16 inches long, and is polished at the end. 56



Giddings & Lewis Floor Type Boring Machine with Three Units Mounted on 102-foot Runway

To obtain additional information on equipment described on this page, see lower part of page 222.

Sundstrand "Rigidmil" for Light Milling Operations

A No. 0 Rigidmil, designed for high-speed milling operations on small parts such as are used in the construction of business machines, electrical apparatus, hardware, small arms, and household machines, has been brought out by the Sundstrand Machine Tool Co., 2531 Eleventh St., Rockford, Ill. This machine is made in both hydraulic- and hand-feed models, as shown in Figs. 1 and 2.

These new machines have been especially designed for easy set-up and the maintenance of accuracy at high production speeds. The pumping unit and controls used on the hydraulic machine have been designed to give smooth, economical operation. Easily adjusted dogs control automatic cycles to meet any practical requirement of conventional or climb-cut milling. The hand-feed No. 0 Rigidmil, sometimes preferred for certain light milling operations, offers the same wide range of spindle speeds as the hydraulic-feed machine.

The hydraulic machine is made in two table sizes. One table, with a working surface of 8 by 34 inches, has a maximum travel of 12 inches, while the other table, with a working surface of 8 by 46 inches, has a travel of 18 inches. The maximum distance from the top of the table to the center line of the spindle is 13 inches, and the minimum distance 2 1/2 inches. The hydraulic feed range is adjustable from 1/2 inch to 38 inches per minute, and the rapid traverse is at the rate of 325 inches per minute. The spindle nose is No. 30 N.M.-T.B.A. Standard. Two ranges of spindle speeds are available by means of pick-off gears. One range gives seventeen speeds from 25 to 1200 revolutions per minute, while the other gives seventeen speeds from 50 to 2400 revolutions per minute. The hand-feed No. 0 Rigidmil has a table 8 by 30 inches with a maximum travel of 14 inches, a 90-degree movement of the hand-lever giving a movement of 4 inches which is adjustable within the 14-inch range.

The foot-mounted spindle motor used on both the hydraulic- and hand-feed machines is of one horsepower and has a speed of 3600 revolutions per minute. The flange-mounted pump motor of the hydraulic machine is 3/4 horsepower and has a speed of 1200 revolutions per minute. The hydraulic No. 0 Rigidmil with 12-inch table travel weighs 2055 pounds; with 18-inch table travel, 2155 pounds; the hand-feed machine weighs 1550 pounds.

A No. 1 Rigidmil with hydraulic feed only is also being placed on the market by this company. This machine has a Sundstrand rectangular overarm and removable outboard braces. The No. 1 Rigidmil is similar to the No. 0 machine, but has a capacity for somewhat larger and heavier work.........57

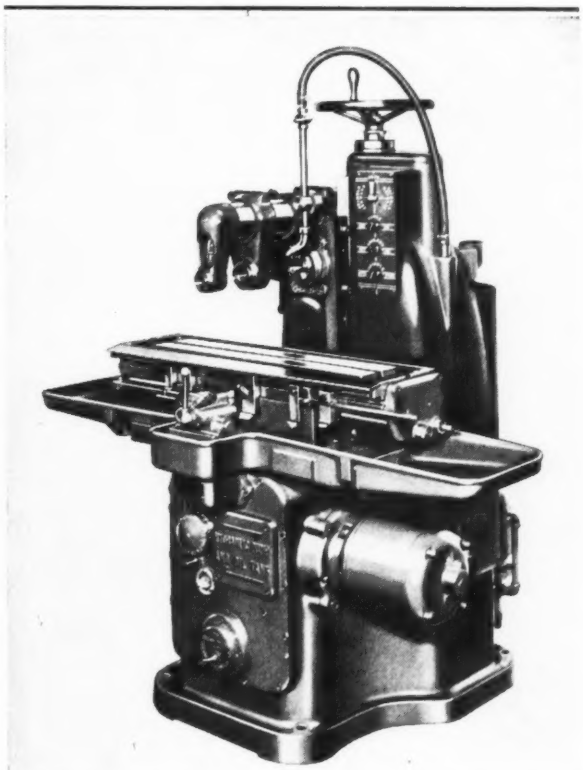


Fig. 1. Sundstrand No. 0 Rigidmil Equipped with Hydraulic Feed

Fig. 2. Sundstrand No. 0 Rigidmil with Hand-lever Feeds for Table and Spindle Head

To obtain additional information on equipment described on this page, see lower part of page 222.

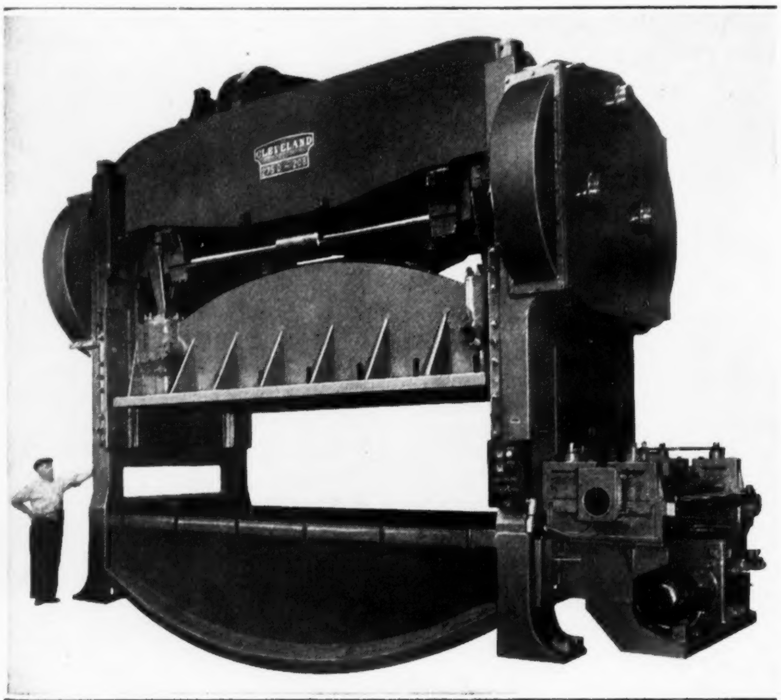


Fig. 1. Cleveland Power Press Equipped with Automatic Roll Feed

Cleveland Power Press and Heavy-Duty Uncoiler

A power press with a bed surface of 94 by 208 inches and an electrically controlled hydraulically operated clutch is a recent development of the Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland, Ohio. In this type of press, the power is applied to all four corners of the slide through connections operating simultaneously through two crankshafts. Accurate alignment is thus maintained between the slide and the bed, whether the work is in the center or off center, so that there is little possibility of the dies overlapping.

This press, as shown in Fig. 1, is equipped with an automatic roll feed which has supplementary rolls for leveling and straightening the material before it reaches the dies, and is designed to operate with the heavy-duty automatic uncoiler shown in Fig. 2. With this equipment, the press has a capacity for feeding 180 inches of 72-inch material at each stroke when operated at 10 revolutions per minute. The feed arrangement and press operation are synchronized through an interlocking system which will automatically stop the press if the correct amount of material is not fed the predetermined distance. This type of press and automatic feed can be furnished in various sizes to suit requirements.

The heavy-duty uncoiler is of the cradle type, and is so designed that as the coil decreases in size all rollers continue to bear on the outside of the coil. Provision is also made against marring or scratching the material. The slide is counterbalanced by air, and all the gearing is located in the crown.........58

Sebastian Type S "Stremeline" Lathes

The Sebastian Lathe Co., Cincinnati, Ohio, has just brought out a new Type S lathe in 12-, 16-, and 20-inch swings to meet the demand for medium-priced, roller-bearing equipped, geared-head lathes. Timken roller bearings are used on all shafts in the headstock, including the spindle.

The geared headstock provides eight spindle speeds, two ranges being available in each lathe size. The feeds range from 0.00175 to 0.222 inch on the 12-inch lathe;

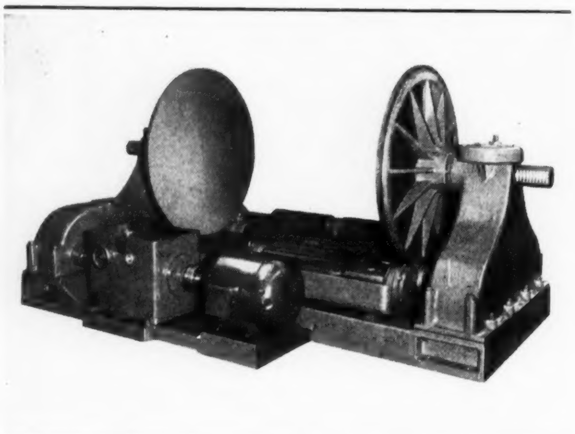
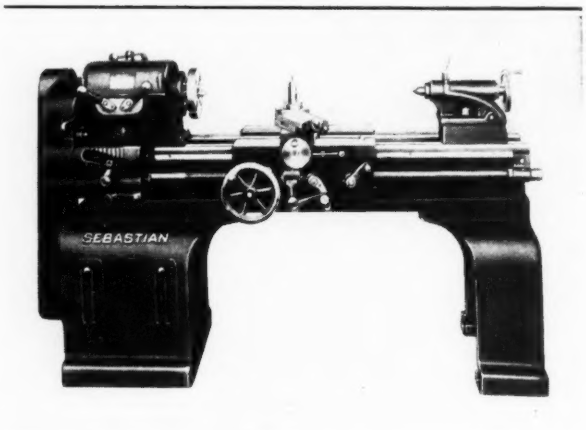
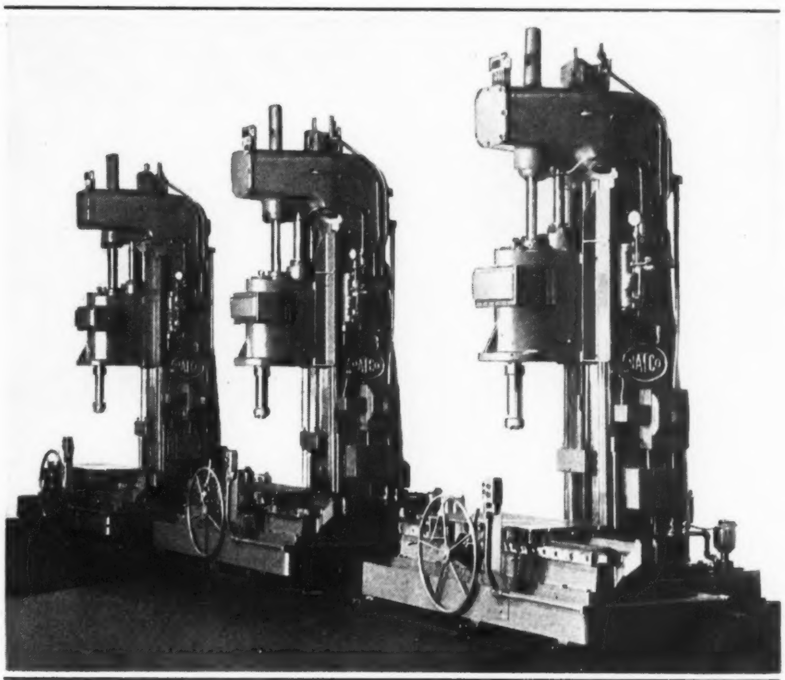


Fig. 2. Heavy-duty Uncoiler Used with Machine Shown in Fig. 1



"Stremeline" Type S Geared-head Lathe Built by the Sebastian Lathe Co.

To obtain additional information on equipment described on this page, see lower part of page 222.



Battery of Three Natco Machines Equipped for Boring and Reaming Cylinders of Large Marine Motors

0.002 to 0.252 inch on the 16-inch size; and 0.008 to 0.252 inch on the 20-inch lathe. The 12- and 16-inch lathes have a thread range of 3 to 384, and the 20-inch lathe, from 3 to 96. A tumbler reverse plate permits left-hand threads to be cut. There is a neutral point in the head that permits the spindle to be revolved freely by hand for chucking work. A quick-acting lever controls the cross-feed. Safety arrangements prevent meshing two trains of gears at the same time, and a safety shear pin is also provided......59

Machines for Boring and Reaming Cylinders of Large Marine Motors

The National Automatic Tool Co., Richmond, Ind., has recently built three Natco Model B250-H vertical cylinder boring machines for performing rough, semi-finish, finish boring, and reaming operations on marine motor cylinder blocks, the blocks passing from one machine to the other. Each machine is arranged with a semi-automatic hydraulic feed, a slow-speed boring head having a 24-inch stroke, and a T-shaped base carrying a hand-operated straight-line indexing fixture. There is a coolant system consisting of a motor-driven gusher type coolant pump with an automatic shut-off which stops the flow of coolant when the tools are idle.

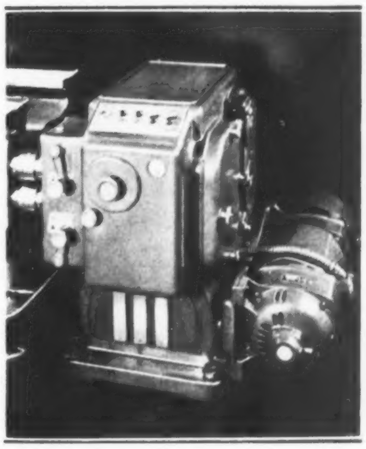
The first machine performs the rough-boring operations on the cylinder bores, the second machine the semi-finish boring operations, and the third the finish-boring operations. Each of these machines operates on one cylinder at a time. After these operations are completed, the blocks are taken to other machines for various drilling operations, after which they are returned to one of the three machines for the final reaming operations. Each of the three machines weighs approximately 17,200 pounds......60

Automatic Sizing Control for Monarch Lathes

The Monarch Machine Tool Co., Sidney, Ohio, has recently developed "automatic sizing" equipment for the engine lathes and tool-room lathes of its manufacture, which converts them into automatic machines for producing parts in quantities of two pieces or more. The "automatic sizing" control is adapted for use on such work as step-shaft turning, step-boring, step-facing, or any combination of step taper and contour turning, boring, or facing work.

The setting-up time required for different jobs may vary from 5 to 15 minutes. Since the set-up time is so short, most lathe jobs can be handled more economically by "automatic sizing," even though there are only two or three pieces in the lot. "Automatic sizing" control assures more accurate duplication of sizes than can ordinarily be obtained by manual control of the lathe.

After engaging the proper switch on the control panel and starting the cut, the operator is free to tend a second machine. His only duties are to load and unload the machines and return the carriages to their starting points, either manually or by the carriage power rapid traverse. The sizing controls are compactly located between the flexible length feed and cross-feed couplings and the motor-generator set. This motor-generator set, which is a standard part of each "automatic sizing" unit, furnishes 15-volt current to the micro-sizing switch and 115-volt current to the feed magnet clutches and brakes......61



Monarch Automatic Sizing Control Applied to Engine Lathe

To obtain additional information on equipment described on this page, see lower part of page 222.

Moline Boring Machine for Diesel Engine Connecting-Rods

The Moline Tool Co., Moline, Ill., has recently designed a special hydraulic-feed, two-column, vertical type machine for boring Diesel engine connecting-rods. The left-hand column of the machine is stationary, being bolted to the base. The right-hand column is movable, being mounted on a massive slide which moves on a V-guide and a flat way on the base. The slide is moved by a motor-driven worm-shaft which actuates a rack-and-pinion traversing mechanism. Push-buttons and safety stopping devices control the traverse motor. A handwheel is provided for accurate adjustment of the distance between spindle centers.

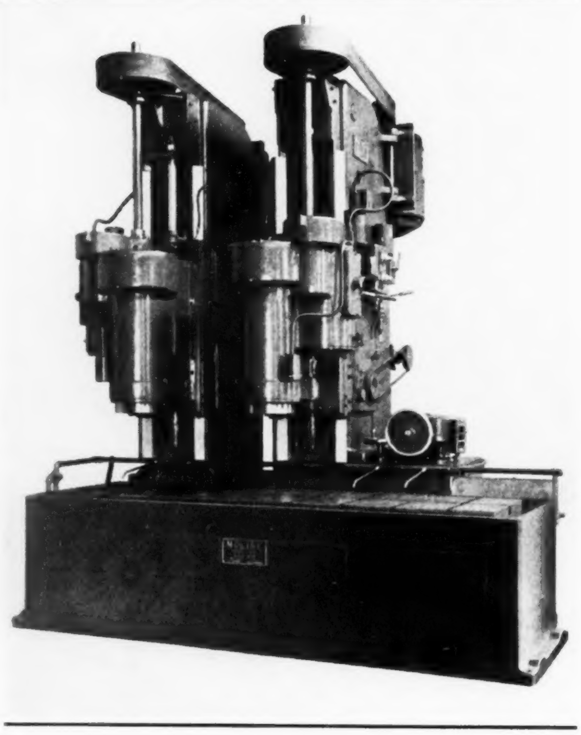
A clamp operated by a handwheel locks the movable column in position. Locating plates are mounted on each column to indicate spindle centers, thus permitting the use of vernier calipers or spacing rods in making settings to exact center distances. Each of the two spindles is driven by a motor having a 3-to-1 speed range through a V-belt drive and a quick-change gear-box. An electrically controlled hydraulic feed traverses the spindles on double V-guides.

This machine has a minimum spindle speed of 5.66 revolutions per minute; a maximum spindle speed of 238 revolutions per minute; a minimum spindle center distance of 20 inches; and a maximum spindle center distance of 60 inches. The minimum feed is 0.125 inch per minute, and the maximum feed 9 inches per minute. The machine will bore holes up to 12 inches in diameter. The base is arranged for the use of coolant. 62

Oster Bolt-Threading Machine

The Oster Mfg. Co., 2057 E. 61st Place, Cleveland, Ohio, has added a new bolt-threading machine known as the "Rapiduction Junior" to its line of threading equipment. This machine is made in two sizes, the No. 541 machine having a capacity up to 1 1/4 inches diameter, and the No. 542, which handles threading work up to 1 1/2 inches in diameter. When the die-head and vise carriage are removed, the machines can be adapted for chamfering, drilling, reaming, boring, tapping, and other jobs.

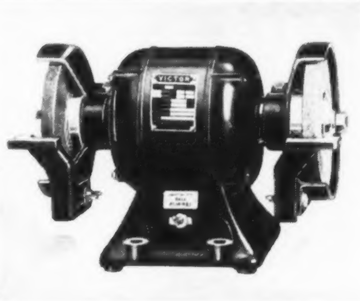
The machines are driven by constant-speed two-horsepower motors having speeds of 1800 revolutions per minute. Speed changes are obtained with pick-off sheaves. The drive from the motor to the machine is through V-belts. Eight spindle speeds are obtainable, ranging from 27 to 386 revolutions per minute. The open type vise is operated by a handwheel. The vise jaws are of hardened steel, one being serrated and the other smooth. The jaws are adjustable both vertically and horizontally for the maintenance of accurate alignment with the die-head. The vise carriage has a travel of 10 inches. 63



Machine Developed by the Moline Tool Co., for Boring Diesel Engine Connecting-rods

Oster Bolt-threading Machine with Rotary Type Automatic, Quick-opening Die-head

To obtain additional information on equipment described on this page, see lower part of page 222.



Stanley 1/4-horsepower Bench Grinder

Stanley "Victor" Bench Grinder

A new bench grinder with a 1/4-horsepower full ball-bearing motor and 6-inch grinding wheels is being placed on the market by the Stanley Electric Tool Division of the Stanley Works, New Britain, Conn. The new grinder is designated the No. 66 "Victor." It is adapted for general grinding, sharpening tools, buffing, polishing, and wire brush work in garages and factories.

This grinder is equipped with sturdy wheel guards, tool-rests, toggle type switch, three-wire rubber-covered cable, rubber feet, and two 6-inch grinding wheels —one coarse and one fine. 64

5500-Ton Press for Airplane Parts

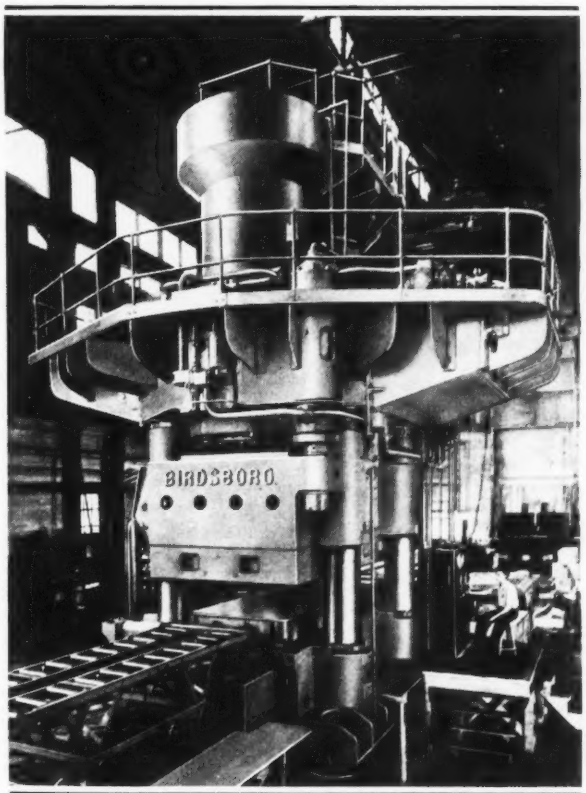
The huge machine here shown is believed to be the largest hydraulic press in the world designed for shearing and forming airplane parts. It is one of a number being constructed by the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., for the Russian Government. This press can exert a working pressure of 5500 tons, has a 54-inch stroke, and a platen 200 by 90 inches.

The speed and pressure are fingertip-controlled. Operation can be either automatic or manual, as desired. The work is loaded into the press and the finished part removed simultaneously by means of synchronized transferring equipment. 65

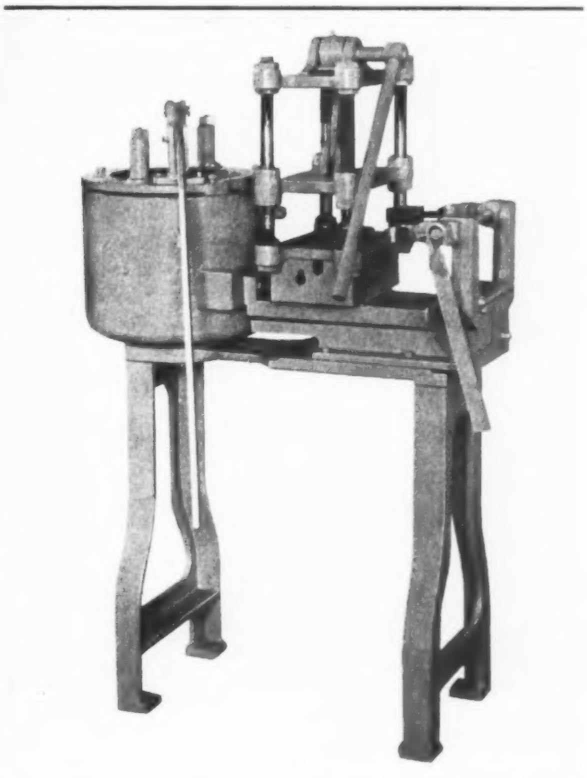
Victor Die-Casting Machine

A complete line of die-casting machines has been developed by the Victor Die Casting Machine Co., 1727 Standard Ave., Glendale, Calif. (formerly at Ypsilanti, Mich., and Santa Barbara, Calif.). This line of die-casting machines was designed to meet the requirements of the small manufacturer, and has been employed for a wide range of products requiring rapid and economical operation. The company is now making two standard models, the Victor Senior and the Victor Junior, as well as special models. Both standard models are available with hand-operated plungers and for air operation.

In the direct air-operated machines, the air is admitted to the enclosed pot under pressure to force the metal into the mold. This type of machine is recommended for aluminum alloys and other metals with casting temperatures from 1000 to 1250 degrees F., between which tempera-



Birdsboro Hydraulic Press Designed for Shearing and Forming Airplane Parts



Victor Senior Model Hand-operated Plunger Type Die-casting Machine with Vertical Die Vises

To obtain additional information on equipment described on this page, see lower part of page 222.

tures plungers are subjected to rapid wear. It is claimed that the formation of dross through oxidation is greatly reduced in this type machine.

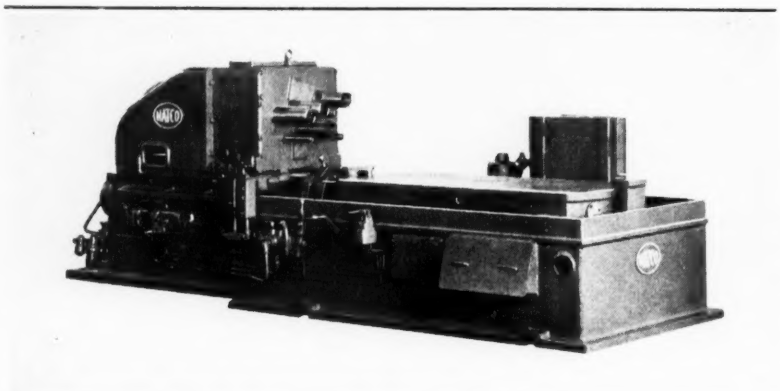
To meet special requirements, the manufacturers have developed vertical operating die vises which can be supplied in place of the horizontal type. The Senior model has die faces 7 by 13 inches and a maximum die thickness of 5 inches. The Junior die faces are 6 by 10 inches and the die thickness ranges up to 4 inches. Plunger type pots hold 80 and 30 pounds of lead for the two models, and enclosed air types hold about 10 pounds more than the plunger type. 66

Natco Horizontal Hydraulic Multi-Spindle Boring Machine

A machine for rough, semi-finish, and finish boring the camshaft and crankshaft bearing holes of large marine motors and also for drilling two 1/2-inch holes in any one of three different gear-cases used in connection with the motors, has been built recently by the National Automatic Tool Co., Richmond, Ind. In addition to the boring and drilling operations, this machine can also be used for facing each side of the camshaft and crankshaft bearings.

The machine consists of a Natco Type C8H hydraulic unit, with a two-rate feed valve, positive stop, and a manually operated directional valve, which is bolted to a steel pedestal and arranged with an indexing type fixture base. Any one of the various work-holding fixtures can be mounted on the indexing base as required. The indexing feature allows the fixtures to be turned or located at any angle, thus permitting the insertion and removal of the boring-bars without interfering with the spindle head on the unit.

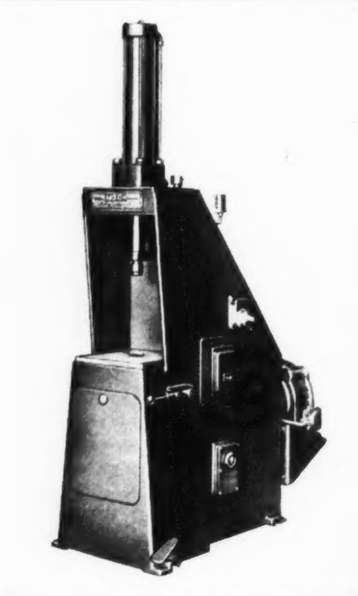
The machine is equipped with a motor-driven type coolant pump having an automatic shut-off which prevents the flow of coolant when the tools are not working. A wide channel around the fixture table returns the coolant to the reservoir in the base of the fixture table. 67



Natco Multi-spindle Machine Equipped for Boring Crankshaft Bearing Holes of Large Marine Motors

Nixon Broaching Machines

A line of presses and broaching machines designed for medium and light surface or internal broaching, ball-sizing, and assembly work on typewriter, electrical, gun, sewing machine, instrument, valve, wrench, and similar parts has been brought out by the Nixon Gear & Machine Co., Inc., Syracuse, N. Y. The bases of these machines are fabricated of steel, electrically welded. The side plates are made in one piece. The hydraulic and coolant tanks are part of the base, and are provided with clean-out ports.



Nixon Vertical Type Broaching Press

The work-plates of these machines are ground, and can be easily removed for mounting work-holding fixtures. The Vickers hydraulic pump is driven through a flexible coupling at motor speed. A sight gage shows the oil level in the large tank in the base of the machine. The pressure gage, mounted at eye level, is provided with a shock arrester and stop-cock.

This line of presses includes two general-purpose, vertical type broaching machines and one universal platen broaching machine. All three types are made in two-, three-, and five-ton sizes, and in strokes of 12, 18, 24, and 30 inches. The illustration shows a vertical type general-purpose broaching press of five-ton capacity and 18-inch stroke. The platen type Model VU (not shown) has a single platen guided in hardened and ground ways. The front surface is finished for mounting broaches, and a removable bracket is mounted on the platen for pulling broaches through a hole in the work-plate. By mounting this bracket on the top of the platen, it can be used for push-broaching. 68

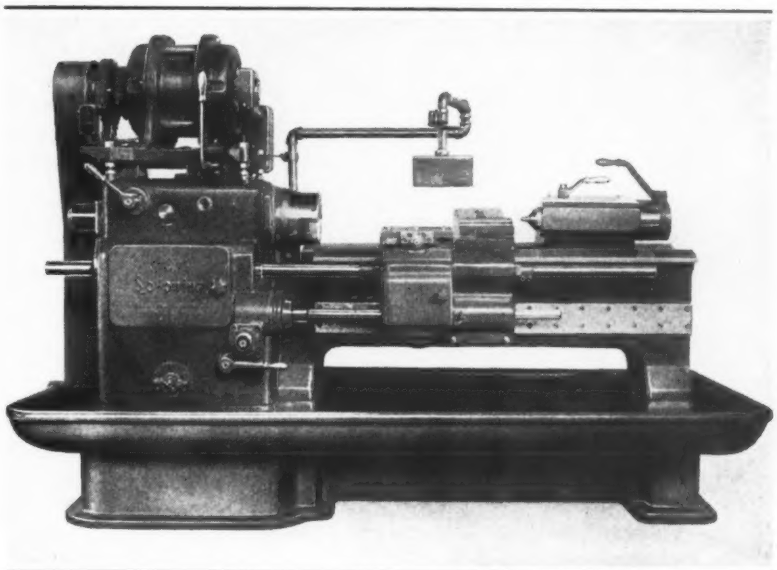
To obtain additional information on equipment described on this page, see lower part of page 222.

Seneca Falls Automatic Lathe

The Seneca Falls Machine Co., Seneca Falls, N. Y., has just brought out a new automatic lathe having several improvements and refinements. The Model LR "Lo-Swing," as the new machine is called, is a fully automatic, cam-operated lathe with a simplified change-over mechanism by means of which the length of the carriage stroke can be quickly varied to obtain accuracy and economy on volume production, as well as on short and medium runs.

This machine has a swing of 5 1/2 inches and will take work up to 46 inches between centers in the longest bed length. It can be equipped with either direct V-belt drive to the spindle for high-speed, fine finishing cuts or with a geared drive, using pick-off gears for slower roughing cuts. It can also be equipped with a third overhead slide, as well as additional back squaring attachments, carriages, and carriage slides.

The constructional features include main carriage support in a direct line with tool pressure, and movement of all tools toward the work on a straight line, thus reducing front clearance on the tool and providing better support for the tip. These features make the machine especially adapted for obtaining maximum efficiency with carbide tools. A throw-out control permits the operator to stop the feed without stopping the spindle, so that no chip is left on the tool point. The lathe, when equipped with a 16-inch bed, weighs 4000 pounds. 69



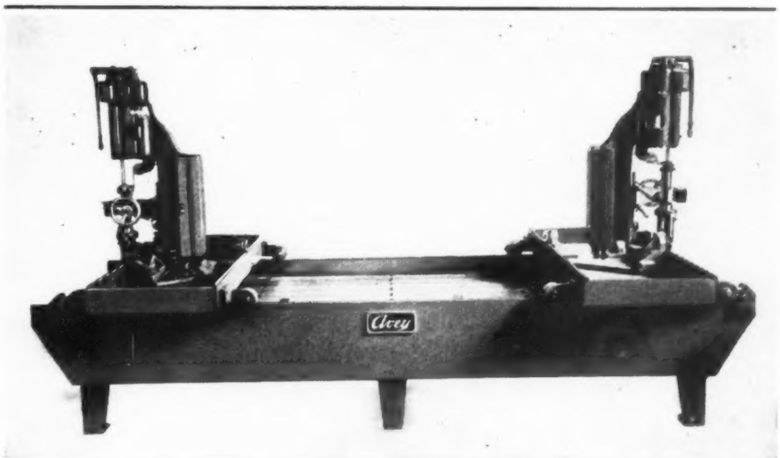
Automatic Lathe Brought out by Seneca Falls Machine Co.

Avey Aircraft Sheet Drilling Machine

A new type of drilling machine has been developed by the Avey Drilling Machine Co., Cincinnati, Ohio, for use in drilling stacked sheets of large size such as are used in aircraft construction. Although designated an "aircraft sheet" drilling machine and originally built for use in the aircraft industry, this machine is adapted for drilling a great variety of plate and sheet materials. The dimensions of the machine beds and of the carriages which provide cross and longitudinal movements for the two drills can be varied to meet requirements, thus making this type of drilling machine suited for a wide field of applications.

The machine consists of a substantial fabricated bed for supporting the stacked sheets and two carriages on which the drilling units are mounted. The longitudinal and cross movements of the drill carriages permit the drills to be located in any desired position above the material to be drilled. The drilling units illustrated are the No. 1 size, Type MA-6, and have capacities for drilling holes up to 1/2 inch in diameter. Drilling units of the No. 2 or No. 3 sizes having capacities for drilling holes up to 1 1/4 inches in diameter can be substituted for the ones shown for drilling iron and steel sheets.

The platen on the machine illustrated is of 2-inch hard wood. This platen is used in drilling through 2 inches of stacked Dural sheets 128 by 40 inches.



Avey Aircraft Sheet Drilling Machine with Capacity for Drilling Stacked Dural Sheets 128 by 40 Inches

To obtain additional information on equipment described on this page, see lower part of page 222.

The small drills used in this case break through into the wood platen, which can be replaced when worn out after a long period of service. Metal platens are also furnished to meet requirements. The carriages are mounted on rollers and can be easily moved to any desired position. 70

Oliver Improved "Arc" Face Milling Cutter Grinder

The Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich., has just brought out a new No. 2 "Arc" face milling cutter grinder which has many improvements over the previous model. The frame of the new machine is heavier and provides a more rigid support for the work-head and grinder head. Important changes have also been made in the work-head and slides, making it easier to change the set-up for grinding either right- or left-hand cutters.

The machine has a capacity for grinding face milling cutters from 6 to 26 inches in diameter, grinding the face, corner, and periphery at one pass of the wheel. The face and periphery of a cutter can be ground to different clearance angles, and the corner can be ground to any radius from 0 to 2 inches.

Channeling cutters can be ground in two operations, once while set as a right-hand cutter and once while set as a left-hand cutter. Small cutters, such as shell end-mills, can be ground with a round corner at one setting by using an auxiliary spindle. 71

Fischer Oil-Grooving Machine

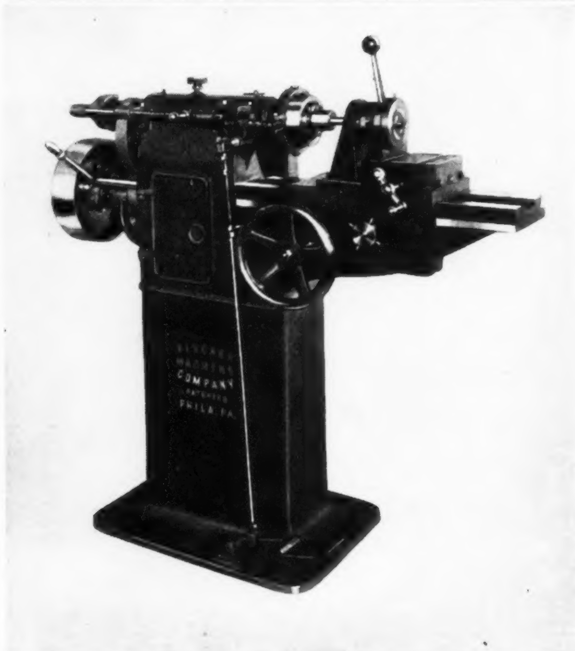
The Fischer Machine Co., 310-16 N. 11th St., Philadelphia, Pa., has recently brought out an oil-grooving machine embodying various improvements over previous models. This machine is designed to permit quick adjustment for cutting any size and style of oil-groove within the scope of the machine.

The bearing in which a groove is to be cut is mounted on a revolving chuck on the work-spindle, and the boring tool is secured to the carriage slide, which has a reciprocating motion timed with the work-spindle and connected by linkage to the crank gear and connecting-rod. With this arrangement, the work can be held stationary, while the tool is reciprocated to produce a straight oil-groove that is parallel to the axis of the bearing.

By holding the tool-slide stationary and revolving the spindle, a round groove can be cut in a plane perpendicular to the axis. Various intermediate forms of grooves can be obtained by making a proper adjustment between the speed at which the work is rotated and the number of strokes per minute made by the tool-slide.

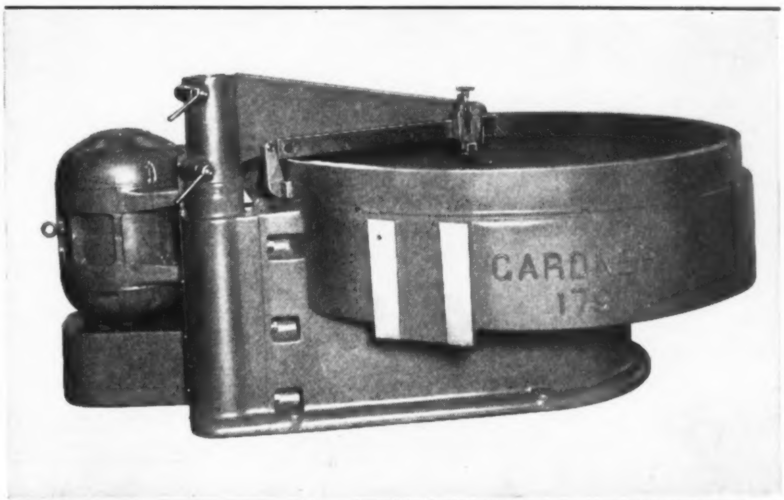
A relieving and taper attachment is provided for cutting oil-grooves in tapered bearings. This attachment makes it possible to cut grooves either straight or taper in the form of a cross, in a straight line the length of the shaft or bushing, in the form of a half-circle around the shaft or bushing, in the form of a right- or left-hand helix, and in various other forms and combinations. Grooves up to 8 inches long can be cut in bushings up to 5 inches inside diameter. The machine will swing work 10 inches in diameter. 72

Oliver Face Milling Cutter Grinder



Fischer Oil-grooving Machine

To obtain additional information on equipment described on this page, see lower part of page 222.



Gardner Disk Grinder with 72-inch Wheel

Gardner Horizontal Disk Grinder

A 72-inch horizontal disk grinder (designated No. 179) which is adapted for numerous operations requiring a flat surface to be produced without any definite relation to other portions of the work, has been brought out by the Gardner Machine Co., 414 E. Gardner St., Beloit, Wis. When equipped with the hand-operated swinging work-table made by this company, the grinder can be used to finish two surfaces of one casting in accurate relationship with each other.

This grinder is designed to meet the requirements of a V-belt motor drive with a standard motor, a 40 horsepower motor having a speed of 1150 revolutions per minute being recommended. A new louver type removable guard ring which assists in the efficient removal of dust and grit produced in grinding is a feature of this machine. A swinging bar dresser provides maximum rigidity and permits the wheel to be quickly dressed at any time. Either wet or dry grinding can be performed, a welded steel settling tank with motor-driven pump and fittings being furnished when the machine is to be used for wet grinding. The application of a heavy-duty abrasive wheel to the steel wheel is a simple operation, as the abrasive is built in six sections to facilitate handling.

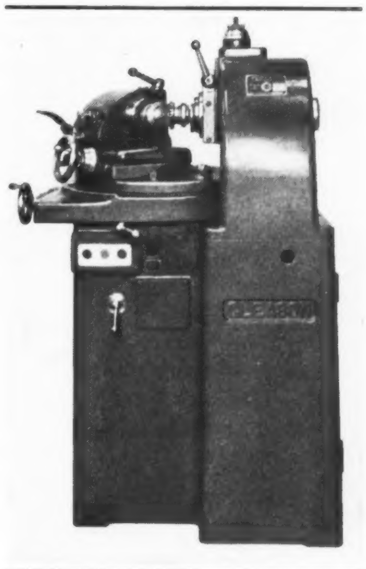
The spindle is mounted on ball bearings, the lower bearing being a combination radial and thrust type, with a rated load capacity of 38,000 pounds. All bearings have dust and waterproof housings. 73

Gleason Angular Gear-Testing Machine

A rigid testing machine for checking the running qualities of bevel and hypoid gears up to 6 3/4 inches in diameter is a new development of the Gleason Works, Rochester, N. Y. This machine will accommodate all shaft angles from 0 to 180 degrees, and pinion shaft offsets up to 1 1/4 inches either above or below center.

The pinion drive head can be operated in either direction at 1750 and 3500 revolutions per minute. The load is applied to the gear-head by a hand-brake, duplicating operating conditions and testing gears for size, spacing, noise, run-out, and tooth contact.

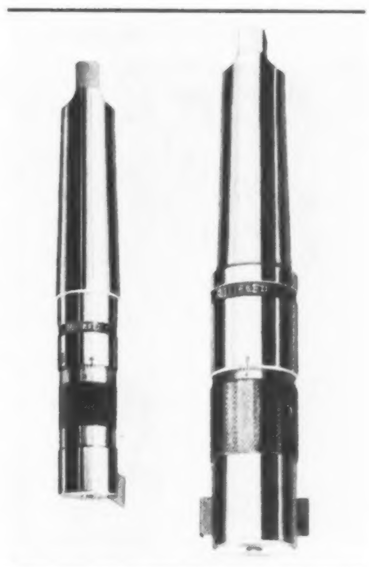
Both spindles are mounted on matched anti-friction bearings, preloaded to eliminate radial or axial deflection. The spindle noses are heat-treated, and the taper holes are ground with the spindles mounted in their own bearings to insure concentricity. The machine occupies a floor space 31 by 36 inches, and weighs 1600 pounds. 74



Gleason Machine for Testing the Running Qualities of Bevel and Hypoid Gears

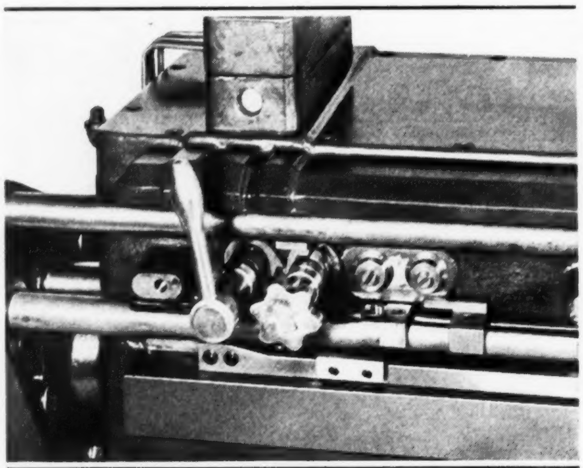
Eclipse "MikrO-LoK" Boring and Reaming Bars

Maximum rigidity and cutting ability, with means for quickly adjusting the blades and locking them in place, are outstanding features of the "MikrO-LoK"

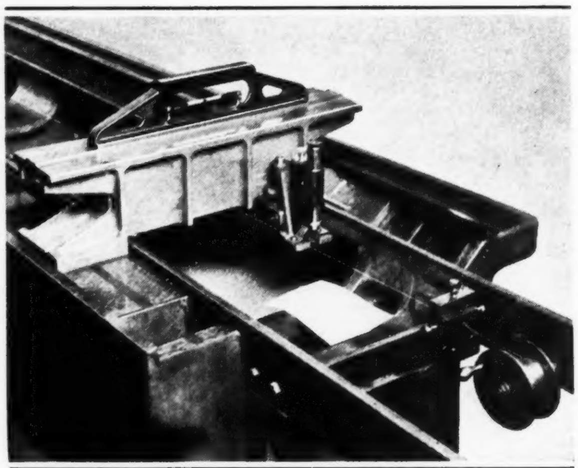


(Left) "MikrO-LoK" Jig Boring Bar. (Right) "MikrO-LoK" Self-aligning Adjustable Reaming Bar

To obtain additional information on equipment described on this page, see lower part of page 222.



Ex-Cell-O Hydraulic Power Unit with Cover Removed to Show Mechanism for Step-drilling



"Microliner" Developed by the Norton Co. for Testing the Straightness of Long V-ways

boring and reaming bars recently placed on the market by the Eclipse Counterbore Co., 7410-30 St. Aubin Ave., Detroit, Mich.

"MikrO-LoK" jig boring tools in sizes from 3/4 to 4 inches in diameter, and high-speed precision boring tools for boring holes as small as 0.500 inch in diamond boring machines are adjustable in increments of 0.00025 inch. Two-bladed fixed type, as well as floating blade boring-bars designed for accurate hole-finishing, are adjustable in increments of 0.0005 inch.

Automatic feed-out type tools for recessing and under-cutting otherwise inaccessible surfaces, and bars having piloting sections both above and below the work, with two or more cutting blades in tandem or independently distributed on the bar for multiple-diameter line-boring, are also made with the "MikrO-LoK" adjustment. When the useful life of the "MikrO-LoK" blades has been exhausted, they can be used in bars of a smaller size. 75

Ex-Cell-O Step-Drilling Unit

Automatic multiple-spindle step-drilling using a single hydraulic power unit or automatic step-drilling of long and relatively large holes has been made possible through the development of a hydraulic control mechanism by the Ex-Cell-O Corporation, 1212 Oakman Blvd., Detroit, Mich. This unit is available with either the Ex-Cell-O 23A or 25A hydraulic power units described in September, 1935, MACHINERY, page 62; and it can be applied, with modifications, to similar units already in use.

The step-drilling unit consists of a feed-bar which moves with the spindle, a stationary positioning bar, and a sliding dog for positioning the action on each step. These members are held on the feed-bar under spring tension. There is also an adjustable hydraulic timer for regulating the depth of cut in each step.

When the machine is started, the drill approaches the work and the sliding dog trips the main operating control, starting the hydraulic timer. When the hole has been drilled to the depth for which the timer is set, the spindle and feed-bar recede and the sliding dog returns with the bar to a new position. A fixed dog on the top feed-bar then trips the hydraulic unit, resulting in rapid approach to the feeding position. Next, the sliding dog trips the operating control, starting the automatic timer and engaging the drilling feed as the previous depth of cut is reached. This cycle continues automatically until the hole is completely drilled. The unit then automatically repositions itself for the next operation. The depth of each step is adjusted by setting the automatic timer. 76

Norton "Microliner"

An instrument designated the "Microliner" has been designed by the Norton Co., Worcester, Mass., to insure the straightness of the V-ways on Norton grinders having long bases. In addition to being used in the construction of machines to insure scraped ways that are straight within accurate limits, this instrument can be utilized by customers in setting up machines to duplicate the original accuracy of alignment and to check the alignment from time to time.

The equipment consists chiefly of a bridge of cast iron, planed and scraped to correspond with the flat and vee base ways; a microscope mounted on the bridge; and a coil of music wire and clamps for holding the wire in position. The microscope has an accurate scale graduated in thousandths of an inch across the optical field, which is illuminated by a dry cell operated lamp built into the instrument.

The music wire, 0.010 inch in diameter, is stretched tightly from end to end of the base so that readings of the microscope are alike at both ends. The bridge is then slid along the ways and readings taken every 2 or 3 feet, all readings being made from the same side of the wire. From the chart of the readings, corrections in alignment can be made by means of the base adjusting screws. 77

To obtain additional information on equipment described on this page, see lower part of page 222.

Colonial Utility Broaching Presses

A complete new line of open-side Utility broaching presses especially adapted for broaching and assembly work on long and bulky pieces is being built by the Colonial Broach Co., Detroit, Mich. The columns of these machines are provided with a long faceplate having several transversely milled T-slots and rows of tapped holes which permit adjusting the table height in 6-inch steps.

The standard clearance between the ram and base is 60 inches on the 6- to 15-ton models, but this clearance can be increased by the use of riser blocks. To facilitate changing the height of these machines, all main valves and controls are located in the head, and the column is of two-piece construction, with the exception of the 2- and 4-ton models. A separate cylinder casting on all models permits rapid change-over of the machines to different tonnages and strokes without changing the entire head.

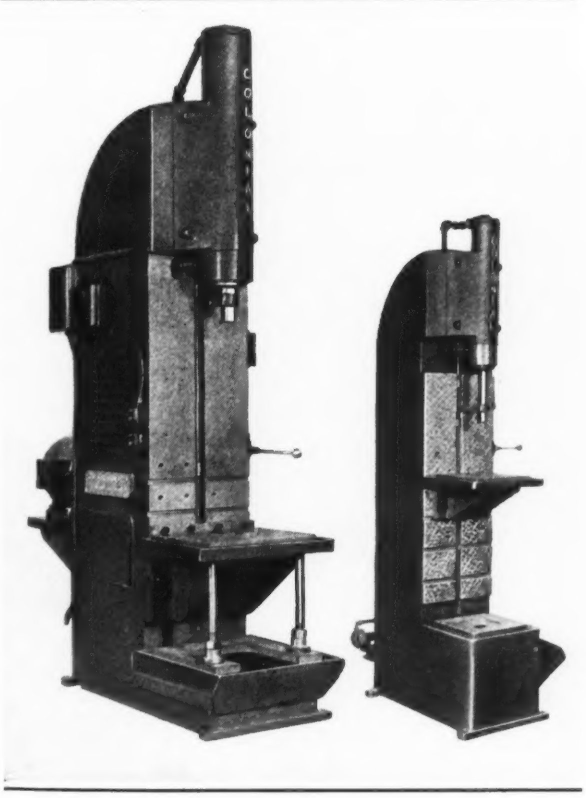
This new line is available in six standard capacities ranging from 2 to 15 tons, with strokes of 18 and 36 inches, but it can be furnished in other capacities if desired. The hydraulic operating mechanism is designed for quick return, and all models are available with either constant or variable working stroke speed. The hydraulic pumps are direct-driven by electric motors with a standard horizontal mounting on the column at the rear of the machine. The presses are so designed that the motors can also be mounted vertically within the column. 78

Universal Segment Type Spring-Coiling Machine

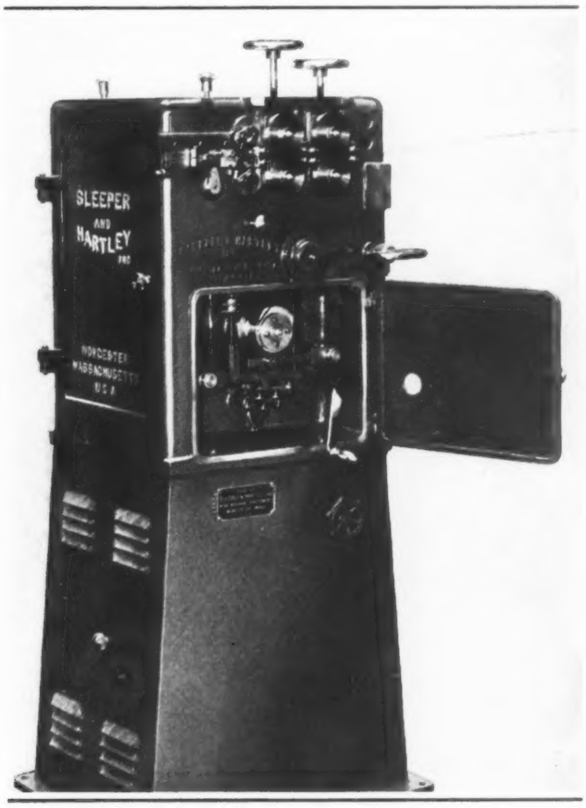
A universal segment type spring-coiling machine, which will coil and cut off all kinds of compression and extension springs from wire ranging from 0.018 to 0.080 inch in diameter at the rate of 16 to 100 springs per minute, has been developed by Sleeper & Hartley, Inc., Worcester, Mass. This machine has many new features, including pitch and diameter cam controls conveniently located in a recess at the front of the machine. A hinged door covers this recess when the machine is in operation. The removable crank shown in the illustration is used for setting up purposes only.

The tooling of this machine is interchangeable with that of previous models. The maximum feed, or wire length per spring, is 48 inches, but auxiliary gearing for doubling the feed on wire sizes up to 0.041 inch can be supplied, and special tools are available for square or rectangular wire.

Springs with inside diameters ranging from 1/8 to 1 inch can be produced in either open or closed styles. Both right- and left-hand springs can be wound.



Colonial 10-ton 36-inch Stroke and 2-ton 18-inch Stroke Utility Presses



Sleeper & Hartley Universal Segment Type Spring-coiling Machine

To obtain additional information on equipment described on this page, see lower part of page 222.

Two-diameter springs, cone-shaped springs of any taper and variable pitch, as well as barrel springs and springs with one or both ends tapered, can be readily produced. The machine is driven by a one-horsepower motor, requires a floor space 20 by 25 inches, and weighs 925 pounds, with motor. 79

Onsrud Air-Turbine Grinder

An air-turbine grinder which is designed for continuous-duty operation at 75,000 revolutions per minute and has an actual rating of 1/6 horsepower, although it weighs only 12 ounces, is being introduced on the market by the Onsrud Machine Works, Inc., 3900-42 Palmer St., Chicago, Ill. This grinder, designated as the B-1, is intended for two purposes—first, as a tool for exceptionally rapid and smooth tool and die grinding; and second, as a marking tool for writing or engraving on all kinds of metals, plastics, glass, porcelain, and other materials. Because of the exceptionally high spindle speed and power, the most difficult die operations can be rapidly performed and a high finish can be obtained.

The grinder will operate in any position, and can be mounted in a lathe toolpost for internal grinding or held in a vise for tool sharpening. It cannot be heated by overloading, and, in fact, operates continuously at less than room temperature. 80

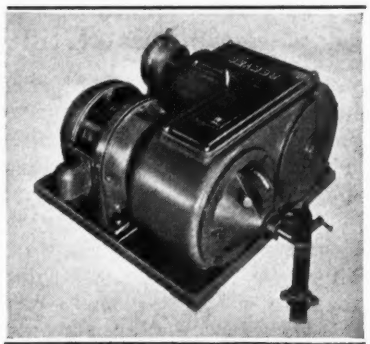
Onsrud Air-turbine Grinder Developing Speed of 75,000 Revolutions per Minute

Wesson Universal Vise Made Entirely of Steel

Wesson Universal Vise

The Wesson Co., 1050 Mt. Elliott Ave., Detroit, Mich., has recently brought out a No. 2 universal vise which is similar to the No. 1 vise made by this company, but is of smaller size and varies somewhat in design. These vises are made entirely of steel and are completely graduated in all planes. They will swing a full 90 degrees in top and side planes and a full 360 degrees in the bottom plane. This universal base is also available with a flat top.

The jaws are of hardened tool steel, the No. 1 vise having jaws 4 inches wide while the jaws of the No. 2 vise are 3 inches wide. The maximum openings between the jaws for these two sizes are 4 and 1 5/16 inches. The No. 1 vise is 6 1/8 inches high, and the No. 2 vise, 4 3/8 inches. 81



Reeves "Motodrive" Equipped for Automatic Control

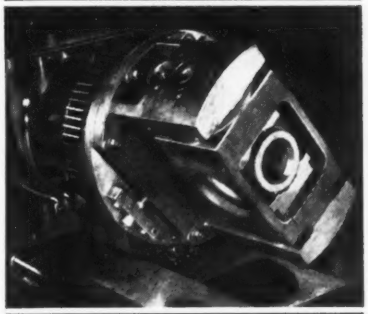
Mechanical Control for Reeves "Motodrive"

A mechanical automatic control for the Reeves "Motodrive" has been brought out by the Reeves Pulley Co., Columbus, Ind. This new control provides entirely automatic speed regulation of the Motodrive unit, which consists of a speed control mechanism, motor, and gear reducer in one assembly. The control makes possible the synchronization of different machines and separate sections of a single machine; constant tension and uniform peripheral winding speeds; and uniform pressure, weight, liquid level, temperature, etc.

On the motor shaft of the Motodrive is a cover plate including a lever bracket and extended lever by means of which automatic control is obtained. This lever can be attached by cable or chain or by direct connection to a properly balanced compensating or floating roll, pressure regulator, moving carriage, or part of machine, etc., from which indication of the required speeds can be taken. Movement of the lever is transmitted to the speed-changing mechanism of the Motodrive to change its speed in accordance with the indicating movement.

Travel of the lever in either direction is limited by stop-screws. The lever can be of any length required by the installation and can be assembled in any one of four different positions. The control is available for all five sizes of Motodrives of both the horizontal and vertical designs. 82

To obtain additional information on equipment described on this page, see lower part of page 222.



Indexing Fixture for Machining Pipe Fittings on Gisholt Lathes

Gisholt Seven-Position Fixture for Machining Pipe Fittings

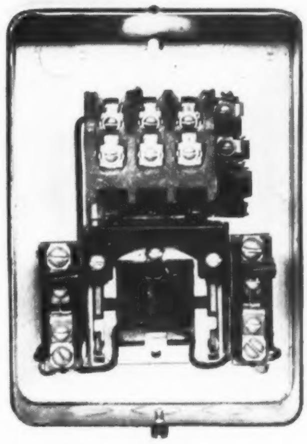
A seven-position indexing fixture for maching tees, ells, crosses, and valve bodies of various sizes, has been brought out by the Gisholt Machine Co., 1209 E. Washington Ave., Madison, Wis., for use on this company's 3AL, 4L, or 5L heavy-duty turret lathes. Machining operations now performed at a single chucking of the work in this indexing fixture previously required the use of several fixtures. The seven indexing positions are 0, 45, 90, 180, and 270 degrees, and two positions approximately 3 degrees off center. The fixture can be arranged for indexing to any desired position or angle. Special jaws or a special cradle adapt the fixture for holding flange pipe fittings or flange valve bodies of different sizes. Valve bodies and pipe fittings from 2 to 5 inches can be held in the fixture shown.

The work is automatically centered by hardened locating pins, and is chucked simply by turning a wrench which opens and closes the jaws. Indexing is accomplished by loosening the clamping plates, raising the hardened steel indexing pin from its seat in the cradle, turning the cradle to the desired position, dropping the pin in its seat, and tightening the clamping plates.

An indexing pin with a hardened steel eccentric which has two positions, one of which indexes the cradle to the right of the center and the other to the left, is used to index the cradle to either of the 3-degree positions. The fixture is free to slide on the faceplate of the machine, and can be adjusted by means of a screw to bring the work in line with the center of the turret. 83

Small Motor Starter for Built-in Applications

A new alternating-current magnetic switch for full-voltage motor starting, which is intended primarily to meet the requirements of machinery manufacturers for smaller built-in mounting control equipment, has been developed by the General Electric Co., Schenectady, N. Y. Although this starter is small and compact, it has been designed in full accordance with the standards for electrical clearances, mechanical strength, and ratings. Its principal features, in addition to its small size, are its conservative electrical design, long life, and low maintenance cost.



G. E. Small Motor Starter with Cover Removed

Basically, the switch consists of a-line contactor, with interlock to provide under-voltage protection, and two isothermic temperature overload relays to protect the motor against over-heating. The open type switch is furnished with a rigid mounting plate to permit easy mounting on either an insulating or conducting panel and it can be set for hand or automatic reset. 84

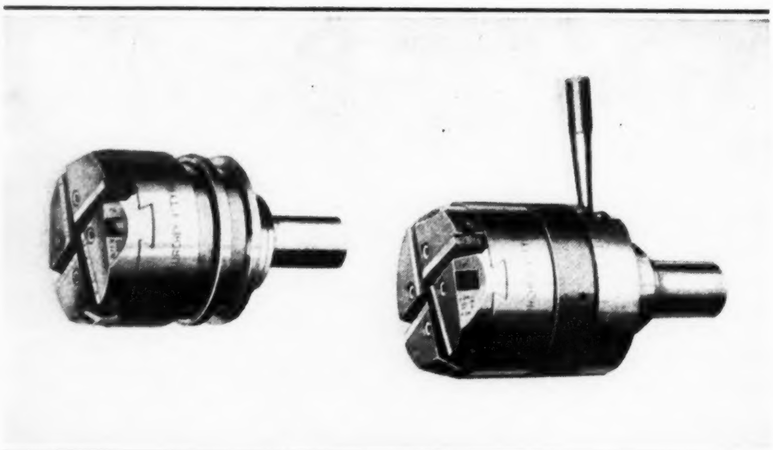
Procunier Universal Tapping Machine

A machine designed for sensitive high-speed tapping which has a tapping capacity range from No. 2 to 5/16 inch in steel, 3/8 inch in cast iron, and 1/2 inch in brass, has been developed by the Procunier Safety Chuck Co., 16 S. Clinton St., Chicago, Ill. This machine has been brought out to meet the demand for a small size tapping machine similar to the larger machine made by this company which was illustrated and described in October, 1937, MACHINERY, page 155. It has four tapping speeds ranging from 390 to 2050 revolutions per minute, and reverse speeds double the forward speeds.

A counterbalanced foot-pedal leaves both of the operator's hands free to handle the work. The tap feeding and reversing pressures are adjustable and are pre-set to meet exact requirements. These pre-set pressures are maintained regardless of the pressure applied to the foot-pedal. The correct flow of lubricant to the tap at precisely the proper instant is supplied automatically by the forced-lubrication system. The machine is available either with or without this lubricating system. 85

Procunier High-speed Tapping Machine

To obtain additional information on equipment described on this page, see lower part of page 222.



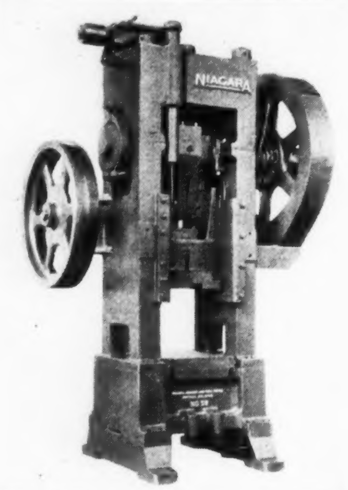
Murchey Types T-C and T-G Die-heads

Murchey Self-Opening Die-Heads

A new series of die-heads having interchangeable tangential chasers designed to give long life and permanent throat, has been introduced to the trade by the Murchey Machine & Tool Co., 951 Porter St., Detroit, Mich. These die-heads are made in two types—the Type T-C and the Type T-G. The heads of both types are made of special alloy steel, hardened and ground throughout, and are designed to cut extremely accurate threads on long production runs.

The Type T-C is a rotating die-head built for use on any machine where the die-head is revolved. It is opened and closed automatically by means of a yoke. The Type T-G is a non-rotating die-head designed to be used on hand screw machines or automatic machines where the die-head does not revolve. This head is of the conventional pull-off type and the opening is also positive and instantaneous. An internal trip can be installed if desired.

Either type of die-head can be used for right- or left-hand threading by using right- or left-hand chaser-holders. The same chasers can be used for either right- or left-hand work by grinding them on the opposite ends and by placing them in the proper holders. High-speed tangential chasers can be furnished with either cut or ground threads. These die-heads are made in four sizes, ranging from 9/16 inch to 1 1/4 inches, with chasers for National coarse and fine threads in sizes from 3/16 inch up to 1 1/4 inches. 86



Niagara Press Equipped with Built-in Single-stroke Mechanism

Niagara Presses with Sleeve Clutch

All plain and single-geared, single-crank presses made by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., in sizes up to and including those having shafts 6 1/2 inches in diameter are being furnished with the Niagara 14-point engagement sleeve clutch with built-in single-stroke mechanism as standard equipment. This clutch, in addition to providing greater capacity, gives instant engagement and eliminates the varying time lag between the depression of the foot-treadle and the actual engagement of the clutch. These advantages result in more strokes per hour and safer operations. 87

Logan Remote Air-Operating System

Logansport Machine, Inc., Logansport, Ind., has developed a new line of remote air-operating systems to simplify the control of air-operated equipment. These systems make possible remote control for air devices, permit operation from conveniently located stations, and are suitable for practically any kind of manual, semi-automatic, automatic, interlocking, or sequence control of one or more cylinders.

Master control valves are installed close to the air cylinder, resulting in short pipe connections and a minimum of friction losses. They are operated either by direct-connected bleeder valves, pressure-operated bleeders, solenoid bleeders, or a combination of these types. Up to 300 reversals per minute have been

Logan Master Control Valve for Remote Air-operating Systems

To obtain additional information on equipment described on this page, see lower part of page 222.